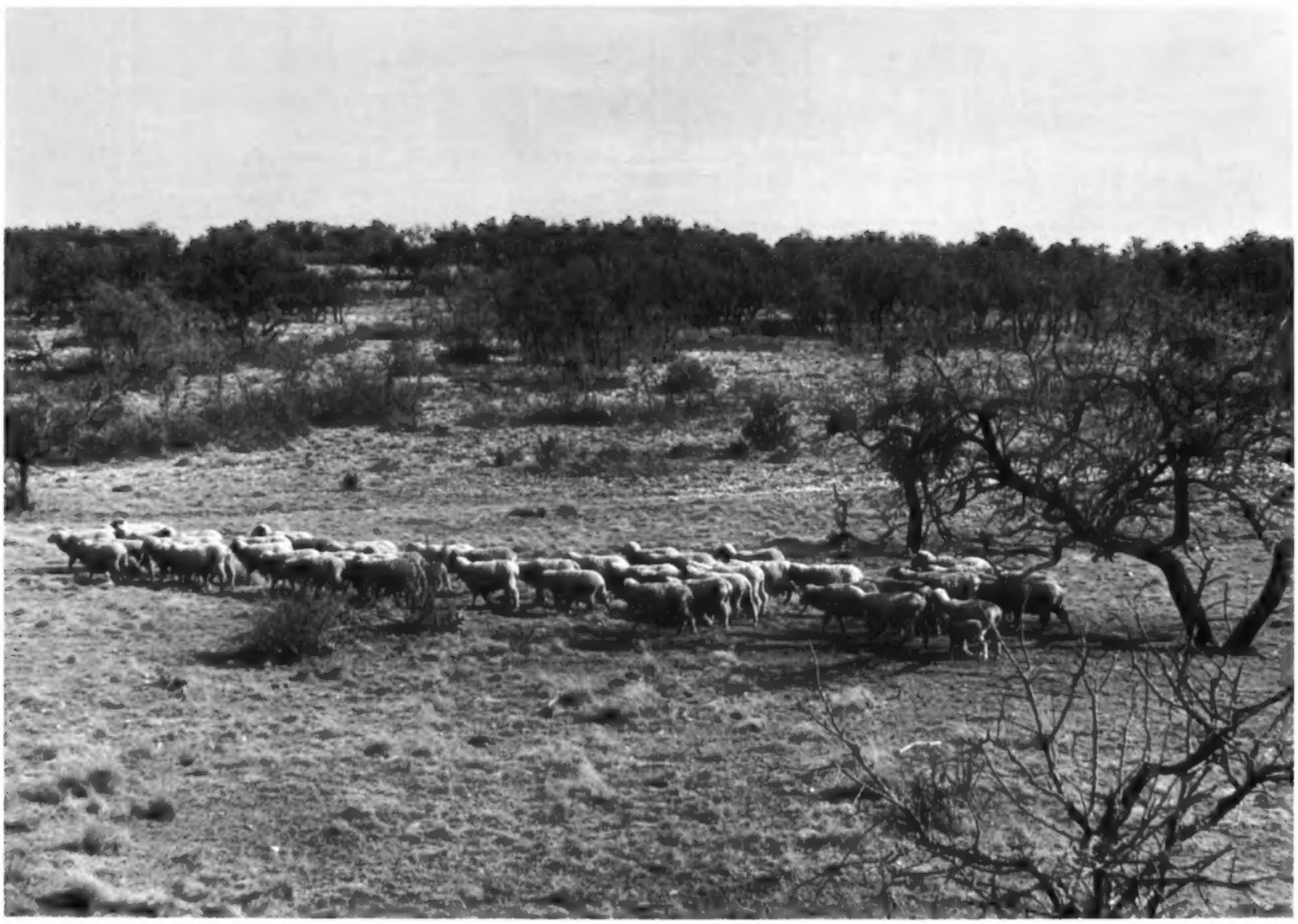
Issued February 1967

SOIL SURVEY

Menard County, Texas



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
TEXAS AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey report was done in the period 1961-65. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1965. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station; it is part of the technical assistance furnished to the Menard and the Concho Soil Conservation Districts.

HOW TO USE THIS SOIL SURVEY REPORT

THIS SOIL SURVEY of Menard County, Texas, contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of Menard County are shown on the detailed map at the back of this report. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the report. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability units, range site, or any other group in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of the interpretative groupings.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Uses of Soils for Wildlife."

Ranchers and others interested in range can find under "Managing Soils for Range" groupings of the soils according to their suitability for range, and also the plants that grow on each range site.

Engineers and builders will find under "Engineering Uses of Soils" tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Genesis, Classification, and Morphology of Soils."

Students, teachers, and others will find information about soils and their management in various parts of the text, according to their particular interest.

Newcomers in Menard County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the Area," which gives additional information about the county.

Cover picture.—Ranching is the main enterprise in Menard County. Sheep are grazing on Tarrant soils of the Low Stony Hills range site.

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Contents

NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on the next page.

Issued February 1967

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF MENARD COUNTY, TEXAS

BY DANIEL R. COFFEE

SOILS SURVEYED BY DANIEL R. COFFEE, OTTO W. BYNUM, AND D. RANDOLPH BURTON, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH TEXAS AGRICULTURAL EXPERIMENT STATION

MENARD COUNTY is in the north-central part of the Edwards Plateau, about 50 miles southwest of the center of Texas (fig. 1). It has an area of 914 square miles, or 584,960 acres. Menard, the county seat, is near the center of the county.

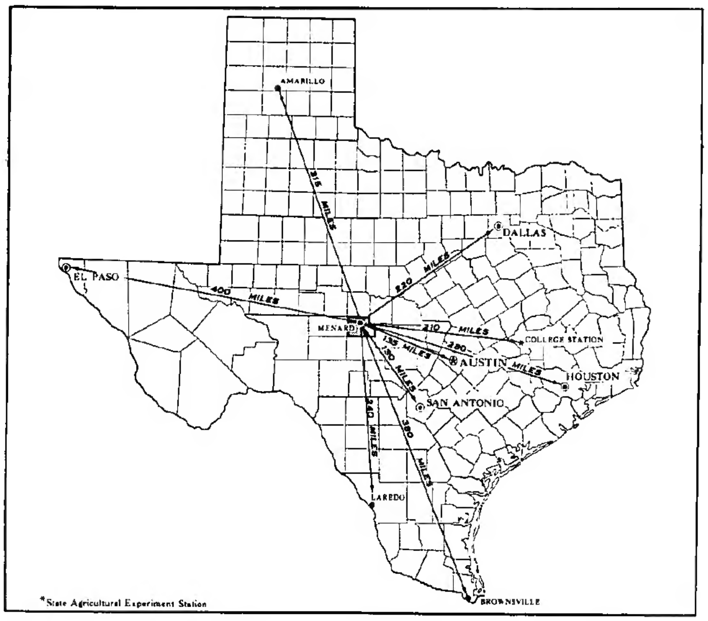

Figure 1.—Location of Menard County in Texas.

The limestone uplands that make up the landscape are dissected by the valley of the San Saba River. The county is mainly in the Edwards Plateau physiographic region, but two small areas in the southeastern corner of the county are part of the Central Basin. In Menard County the Central Basin consists of valleylike areas below the Edwards Plateau.

The climate is semiarid and continental. The summers are very hot and dry, and the winters are generally mild, but there are occasional short periods of cold weather. The average annual rainfall is 22 inches.

Agriculture is the main enterprise in the county. About 96 percent of the acreage is rangeland and is grazed by cattle, sheep, and goats. Also, most of the cropland is planted to crops that are used for grazing. About 2,200 acres along the San Saba River is irrigated. Grain sorghum is the chief row crop, and alfalfa, cotton, corn, wheat, and peanuts are grown in small acreages. Native and improved pecan trees grow in the valley of the San Saba River and on the flood plains of large creeks.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Menard County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the country, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. For successful use of this report, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Tarrant and Valera, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in

texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Menard fine sandy loam and Menard loam are two soil types in the Menard series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Menard fine sandy loam, 1 to 3 percent slopes, is one phase of Menard fine sandy loam, a soil type that ranges from nearly level to sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show roads, buildings, field borders, trees, and other details that greatly help in drawing soil boundaries accurately. The soil map in the back of this report was prepared from such aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Tarrant-Kavett complex, nearly level. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rough broken land or Terrace escarpments, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. On the basis of the yield and practice tables and other data, the soil scientists set up trial groups, and then test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this report shows, in color, the soil associations in Menard County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

One of the four soil associations in Menard County is in low-lying areas of the uplands; one consists mainly of shallow soils of the limestone uplands; one is on stream terraces, mainly along the larger creeks; and one is on the flood plains and terraces of the San Saba River.

1. Menard-Hext association: Deep, loamy soils of the uplands

Two low-lying areas of loamy farmland—one in the Hext community and the other in the Erna and Saline communities—make up this soil association. The soils are loamy. They have a reddish or brown subsoil and have formed from weakly consolidated, calcareous, loamy material or conglomerate of Lower Cretaceous age. The association is undulating or gently undulating and slightly eroded or moderately eroded. It has a total area of about 19,900 acres and makes up about 3 percent of the county.

The major soils of this association are the Menard and the Hext, but there are small areas of many other soils (fig. 2.) The Menard soils occupy the gentle slopes, and the Hext soils are on the low ridges and knolls.

The Menard soils have a dark-brown fine sandy loam or loam surface layer about 8 inches thick. Their subsoil is reddish-brown to red or yellowish-red sandy clay loam that has blocky structure. Limy underlying material occurs at a depth of 20 to 40 inches. The Menard soils occupy about 48 percent of the association.

The Hext soils have a calcareous brown fine sandy loam surface layer about 12 inches thick. It is underlain by brown to reddish-brown, crumbly fine sandy loam that has weak blocky or prismatic structure. The Hext soils occupy about 11 percent of the association.

Of the minor soils in this association, the Frio and the Dev soils occupy the flood plains of the creeks. The Karnes and the Brackett soils are on the foot slopes of

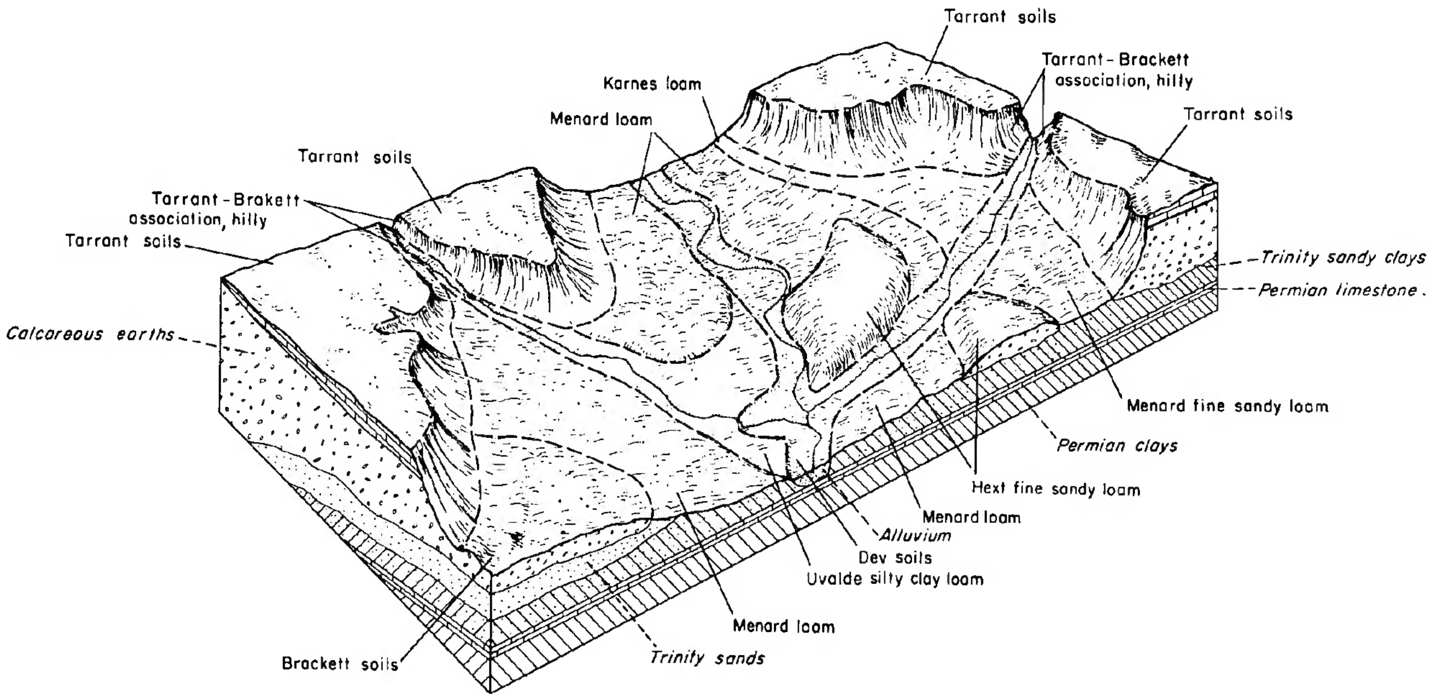

Figure 2.—**Soils of the Menard-Hext soil association.**

the limestone hills. The Tarrant, Valera, Kavett, and Tobosa soils occupy areas that are underlain by limestone. The Stephenville and the Nimrod soils are on low sandy ridges in the Saline and Erna communities. The Uvalde and the Knippa soils are on the stream terraces. Together these minor soils make up about 41 percent of the association.

Most of this association is in small farms, and much of the acreage is cultivated. Most cultivated fields are planted to temporary grasses, or to oats for grazing and for grain, but grain sorghum, cotton, corn, peanuts, and other row crops are also grown. Yields are low except in favorable seasons, which occur about once in 5 years. By selling hunting leases, ranchers and the owners of large farms increase their income. Deer, turkeys, doves, and quail are the most important game. Most areas of this association can be reached by paved or graded roads.

2. Tarrant association: Very shallow soils of the limestone uplands

This association consists of dark, very shallow, clayey soils over limestone. Most of the association is undulating, but the breaks to the valley of the San Saba River and the Central Basin are steep (fig. 3). Soil erosion is slight. This association has a total area of about 515,100 acres and makes up about 88 percent of the county.

This association consists mainly of the Tarrant soils. These soils are thin, dark-brownish clays and clay loams that are underlain by hard limestone at a depth of 2 to 10 inches. About 70 percent of the association is stony, cobbly, channery, gravelly, or cherty. The underlying hard limestone is fractured. Tarrant soils are mildly alkaline to calcareous. They make up about 86 percent of the association.

Also in this association are small areas of Brackett, Valera, Kavett, Uvalde, Knippa, Dev, and Frio soils. The Brackett soils, which occupy the lower part of steep slopes, are light colored and are underlain by soft marl or by loamy, calcareous material. The Valera soils occur in shallow valleys and are moderately deep. The Kavett soils are shallow and occur on gentle slopes. On stream terraces are the deep, friable Uvalde soils. The Knippa soils also are deep and occupy stream terraces, but they are firm silty clays. The Frio soils are on bottom land and are deep. The moderately deep to shallow, stony and gravelly Dev soils lie along small streams and are frequently flooded. The total acreage of these minor soils amounts to about 14 percent of the association.

Most of this association is in range. The very shallow soils effectively use the water from showers and light rains, and they are considered by ranchmen to be good for grass production. During heavy rains, runoff is excessive on the shallow soils because their capacity to store water is low. Cattle and sheep are the main livestock in this association, but some goats are raised for mohair. Some ranchers add much to their income by selling hunting leases. Deer and turkeys are abundant in most areas. Quail and doves also are common. Most, but not all, of the association can be reached by public roads or ranch roads.

3. Knippa-Uvalde association: Deep, fine textured and moderately fine textured soils of the stream terraces

This association consists of wide valleys in which there are deep, nearly level and gently sloping soils that are only slightly eroded. It occupies the stream terraces parallel to some of the large creeks in the county and an area of high terraces north of the San Saba River near the Menard-Mason County line (fig. 4). The terraces along the creeks are about 2 to 10 feet above the small flood plains. The high terraces are 50 to 100 feet

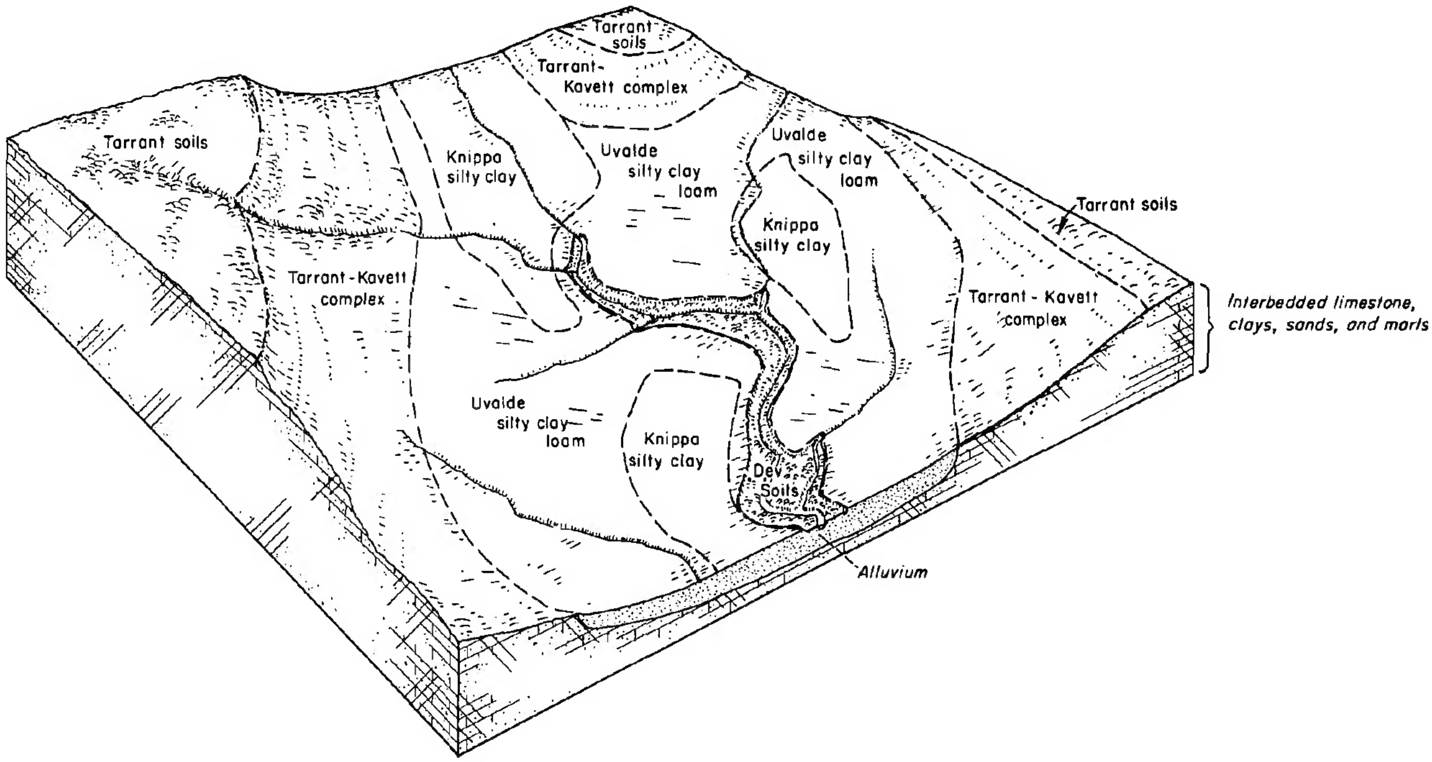

Figure 3.—**Soils of the Tarrant soil association.**

higher than the flood plain of the river and are separated from the river by an area of Tarrant soils. This association has a total area of about 23,300 acres and makes up about 4 percent of the county.

The Knippa and Uvalde are the main soils in this association. The Knippa soils occur in the nearly level, lower parts of the valleys, and the Uvalde soils occupy the more sloping, higher parts. The Knippa soils have a dark grayish-brown clay surface layer 10 to 20 inches thick. Their subsoil is reddish-brown to dark-brown, firm clay that has very fine blocky structure. The Knippa soils crack deeply when they dry. They occupy about 45 percent of the association.

The Uvalde soils have a dark grayish-brown to grayish-brown silty clay loam surface layer that crumbles easily and is 8 to 18 inches thick. Their subsoil is crumbly, brown silty clay loam that has subangular blocky structure. These soils occupy about 37 percent of the association.

The Dev and Valera soils also occur in this association. The Dev soils are on the narrow flood plains along stream channels. They consist of deep to moderately deep, stony, cobbly, or gravelly alluvium that is frequently flooded. Valera soils occupy areas that are underlain by limestone at a depth of a few feet. Both Valera and Dev soils receive runoff from other soils and produce large amounts of forage. The Dev soils make up about 9 percent of the association, and the Valera soils about 7 percent. The remaining 2 percent is made up of the Frio, Kavett, and Tarrant soils.

Although about 90 percent of this association is arable, large ranches, mainly in native range plants, make up most of the area. The range receives runoff from higher lying areas of the Tarrant soils and produces much herbage. Cattle, sheep, and goats are raised. Much income comes from the sale of hunting leases. Deer and turkeys are abundant in most areas, and quail and doves are common. Most areas of this association are accessible by graveled and paved roads.

4. Frio-Uvalde association: Deep, moderately fine textured soils on flood plains and terraces

Nearly level or very gently sloping flood plains and terraces along the San Saba River make up this association. The flood plains are separated from the terraces by long, narrow bands of gravelly terrace escarpments. The soils in this association consist of clay loams and silty clay loams that formed in material washed from the limestone uplands. This association extends in an east-west direction across the center of the county and ranges from 1 to 2 miles in width. It has a total area of about 25,800 acres and makes up about 5 percent of the county.

The Frio and Uvalde are the main soils in this association. The Frio soils occupy the flood plain of the San Saba River. The Uvalde soils occur as nearly level to gently sloping terraces 10 to 30 feet above the Frio soils.

The Frio soils have a dark grayish-brown, friable clay loam surface layer 10 to 24 inches thick. The surface layer is underlain by grayish-brown or brown, firm but crumbly silty clay loam that has subangular blocky structure. At a depth of 5 to 10 feet, most areas of Frio soils are underlain by beds of waterworn gravel, which contain water through most of the year. These Frio soils occupy about 39 percent of the association.

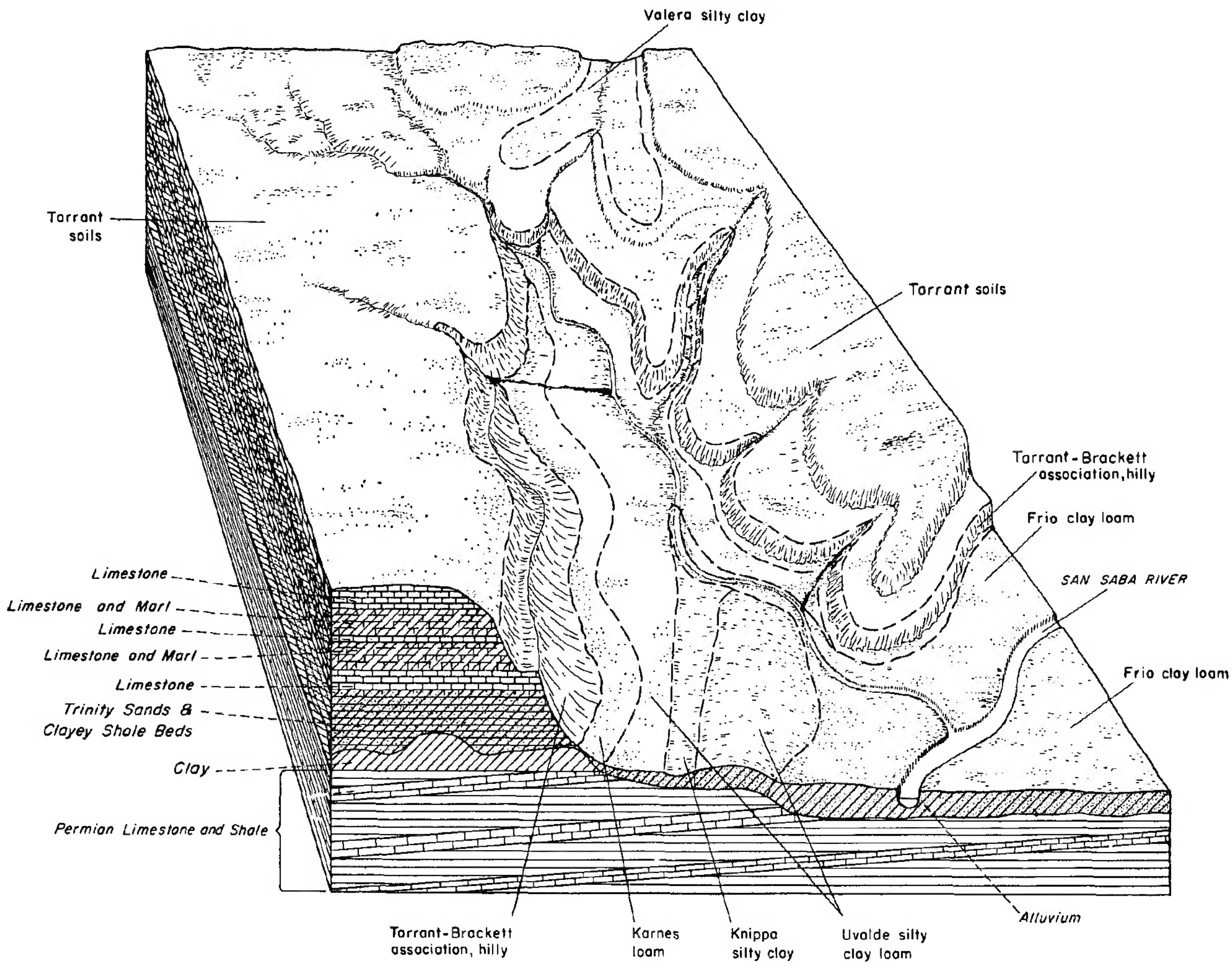

***Figure 4.*—Soils of the Knippa-Uvalde soil association.**

The Uvalde soils have a surface layer that is similar to the surface layer of Frio soils but somewhat lighter colored. Their subsoil is crumbly, brown silty clay loam that has blocky structure and is underlain by pink, limy material at a depth of about 32 inches. The Uvalde soils occupy about 37 percent of the association.

Also in the association are Terrace escarpments and Knippa, Tarrant, Kavett, Valera, and Dev soils. Terrace escarpments occupy the short scarps at the front of terraces. These escarpments are variable, but in most places their soil material is light-brown, calcareous gravelly silty clay loam. Gravel and stones make up as much as 50 percent of the soil mass. These escarpments occupy about 12 percent of the association.

The Knippa soils occupy nearly level areas on the terraces. They have a dark grayish-brown clay surface layer and a blocky subsoil. The Knippa soils make up about 4 percent of the association. Like the Uvalde soils, the Knippa soils are on nearly level to gently sloping terraces 10 to 30 feet above the Frio soils. The Valera and Kavett soils are on the gentle slopes at the outer edges of the association, and the Dev soils are near stream channels. Some areas of the Frio soils are frequently flooded, for they occupy low-lying areas adjoining the river channel. These areas are subject to scouring and may receive deposits from the frequent floods. They occupy about 1 percent of the association. The remaining 7 percent of the area is made up of the Tarrant, Valera, Kavett, and Dev Soils.

About half of this association is cultivated. The irrigated area amounts to about 2,200 acres. Yields under dryland farming are limited according to the amount of moisture received. The irrigated crops are alfalfa, cotton, sorghum, and improved pastures. About 4,000 acres of the Frio soils is in native pecan trees, or trees that have not been budded or grafted to improved varieties. Improved pecans are grown in several small orchards. The yield of pecan orchards is limited by the kind of trees and by the intensity of management. Single trees have yielded as much as 800 pounds of pe-

cans. Most crops of native pecans are destroyed each year by insects. This association also provides a habitat and water for wildlife. Deer and turkeys drink and feed along the San Saba River and creeks in the sparsely populated areas. Beavers can be found along the rivers. Migratory birds, including waterfowl, winter near the streams. Most areas are accessible by graveled and paved roads.

Descriptions of the Soils

This section describes the soils series (group of soils) and single soils (mapping units) of Menard County. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure of this section is first to describe the soil series and then the mapping units in the series. Thus, to get full information of any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Rough broken land and Terrace escarpments are miscellaneous land types but, nevertheless, are listed in alphabetic order along with the series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the details soil map. Listed at the end of each description of a mapping unit are the capability unit and the range site in which the mapping unit has been placed. The pages on which the capability unit and each range site are described can be found by referring to the "Guide to Mapping Units" at the back of this report.

Soil scientists, engineers, students, and others who want detailed descriptions of the soil series should turn to the section "Genesis, Classification, and Morphology of Soils." Many terms used in the soil descriptions and other sections are defined in the Soil Survey Manual (*5*)[1] and in the Glossary.

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Soil	Area	Extent
	Acres	*Percent*
Brackett soils, 2 to 5 percent slopes	2, 947	0. 5
Dev soils	11, 222	1. 9
Frio clay loam, 0 to 1 percent slopes	6, 033	1. 0
Frio clay loam, 1 to 2 percent slopes	3, 554	. 6
Frio soils, frequently flooded	1, 678	. 3
Frio soils, shallow variants	3, 152	. 5
Hext fine sandy loam, 2 to 5 percent slopes	2, 227	. 4
Karnes loam, 2 to 5 percent slopes	1, 560	. 3
Kavett silty clay, 0 to 3 percent slopes	12, 778	2. 2
Knippa silty clay, 0 to 2 percent slopes	12, 083	2. 1
Menard fine sandy loam, 1 to 3 percent slopes	4, 048	. 7
Menard fine sandy loam, 3 to 5 percent slopes	416	(1)
Menard loam, 0 to 2 percent slopes	4, 729	. 8
Mereta clay loam, 0 to 2 percent slopes	3, 926	. 7
Nimrod loamy sand, 0 to 3 percent slopes	342	(1)
Rough broken land	473	(1)
Stephenville loamy sand, 0 to 3 percent slopes	760	. 1
Tarrant soils, undulating	401, 030	68. 9
Tarrant-Brackett association, hilly	22, 091	3. 8
Tarrant-Kavett complex, nearly level	41, 565	7. 1
Terrace escarpments	3, 209	. 5
Tobosa clay, 0 to 1 percent slopes	277	(1)
Tobosa clay, 1 to 3 percent slopes	294	(1)
Uvalde silty clay loam, 0 to 1 percent slopes	5, 677	1. 0
Uvalde silty clay loam, 1 to 3 percent slopes	14, 198	2. 4
Valera silty clay, 0 to 3 percent slopes	23, 905	4. 1
Water	786	. 1
Total	584, 960	100. 0

[1] Less than 0.1 percent.

[1] Italic numbers in parentheses refer to Literature Cited, p. 49.

Brackett Series

The Brackett series consists of light-colored, loamy soils that contain much lime. These shallow and very shallow soils are underlain by soft limestone and chalky marl. They occur on gentle to steep slopes below limestone hills (fig. 5).

The surface layer of the Brackett soils is friable, light brownish-gray gravelly clay loam about 10 inches thick.

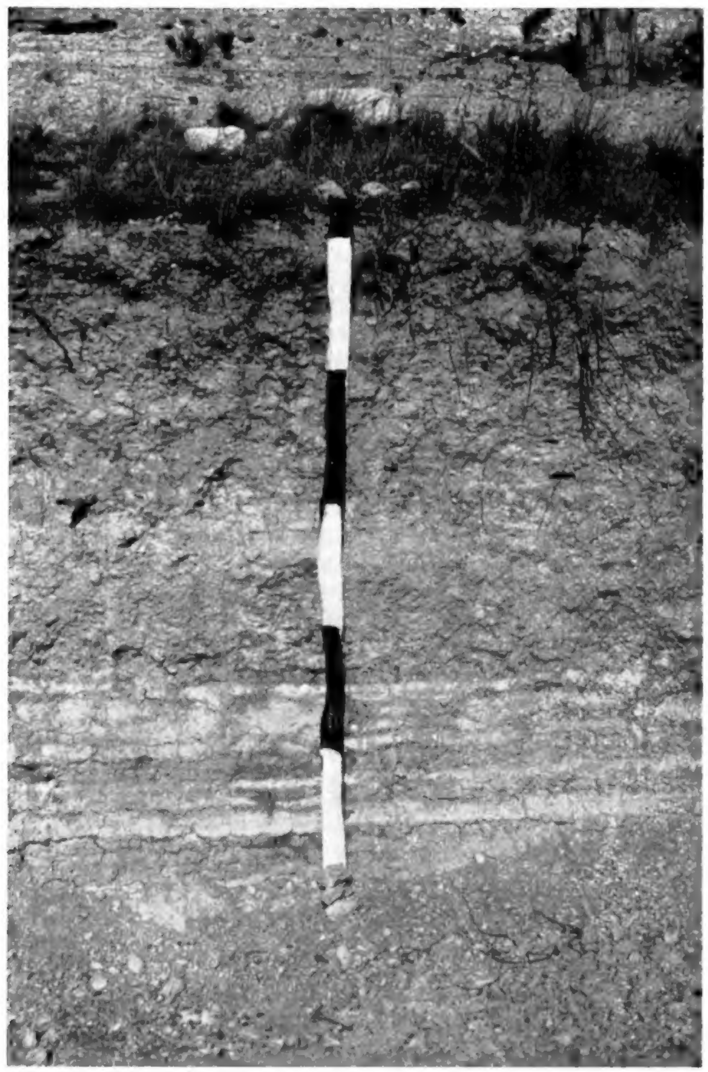

Figure 5.—**Profile of Brackett gravelly clay loam showing the underlying limy earth.**

It has blocky and granular structure and contains many fine fragments of limestone. The substratum is pale yellow; it contains many small pockets and seams of lime and many small fragments of limestone and shells.

Brackett soils are crumbly and easily worked. They have low fertility and a low to moderate capacity to hold moisture. Surface crusting is severe, and erosion is slight.

Most of the acreage of Brackett soils is in grass, but a small acreage in the Hext and Saline communities is cultivated. These soils are best suited to grass, but well-managed areas produce moderate yields of oats for winter grazing.

Brackett soils, 2 to 5 percent slopes (BaC).—These soils occur on gently sloping low ridges and foot slopes in the eastern part of the county. In most places the areas are long and narrow and range from 5 acres to about 100 acres in size. Slopes typically are about 3 percent. Erosion is slight.

The surface layer is about 9 inches of loam to clay loam. It is underlain by a very pale brown layer, about 8 inches thick, that has about the same texture as the surface layer but contains many fine fragments of soft limestone. The substratum is mottled with olive brown and white and contains a few thin plates of brittle limestone.

Included with these soils in mapping are small areas of Mereta clay loam, of Tarrant soils, undulating, and of Hext fine sandy loam.

A few areas are cultivated, but most of this mapping unit is in range. Oats and sudangrass are the tilled crops most commonly grown. The soils have low fertility and are marginal for crops. They contain a small amount of organic matter and available plant nutrients and are somewhat droughty. (Capability unit IVe–2 (dryland); Adobe range site)

Dev Series

The Dev series consists of moderately deep to deep, nearly level to gently sloping, gravelly and stony, calcareous soils on the flood plains of streams throughout the county.

The surface layer of Dev soils varies but in many places is dark grayish-brown gravelly clay loam about 20 inches thick. It is calcareous, and about 50 percent of it, by volume, is coarse fragments. The substratum is grayish-brown, calcareous very gravelly clay loam about 30 inches thick. About 80 percent of the substratum is coarse fragments. Limestone bedrock is at a depth of about 52 inches.

The Dev soils are well drained and have slow to medium runoff. Permeability is rapid in the substratum. The Dev soils are best suited to range.

Dev soils (Ds).—These soils consist of stony, cobbly, and gravelly alluvial materials in frequently flooded areas on the flood plains throughout the county. They are moderately deep to deep clay loams and silty clay loams.

Along the small streams, the areas of these soils are long and narrow. The soils vary greatly in depth, texture, and the content of stones and gravel. The Dev soils along the San Saba River are stony and severely scoured.

Included in mapping are some areas in which the stones or gravel in the surface layer make up less than 50 percent of the layer, by volume.

The areas of these soils slope gently toward the streams and also downstream. Some live oak and a few pecan trees grow near the streams. Because of the stones and frequent flooding, these soils are not tillable. They are fairly good soils for range. Most areas receive water as runoff from surrounding higher soils and produce a good growth of mid and tall grasses. These soils provide a good habitat for wildlife. (Capability unit VIw–1 (dryland); Valley range site)

Frio Series

The Frio series consists of deep, crumbly, nearly level to gently sloping, calcareous soils on the flood plains of the San Saba River and the large creeks throughout the county.

The surface layer of Frio soils extends to a depth of about 15 inches and is dark grayish-brown clay loam that contains much lime. It has granular structure to the depth usually plowed but has blocky and subangular blocky structure below plow depth. Underlying the surface layer and extending to a depth of about 36 inches is dark-brown or grayish-brown clay loam. The substratum is brown to light-brown loamy alluvium that is rich in lime. On the flood plain of the San Saba River and some of the large creeks, the Frio soils, at a depth of 5 to 15 feet, are underlain by beds of waterworn gravel (fig. 6). These beds contain water during wet periods. In other areas the soil is underlain by limestone at a depth of 2 to 4 feet.

The Frio soils are crumbly and loose throughout and are easily worked. Roots and moisture penetrate deeply. Fertility is adequate for dryland farming, but applications of fertilizer benefit crops during the wetter years and in irrigated areas. Erosion is not excessive on the Frio soils. To improve the distribution and penetration of water, land leveling and smoothing are needed in irrigated areas.

Less than half the acreage of the Frio soils is cultivated. About 2,000 acres is irrigated. The soils are well suited to cotton, grain sorghum, oats, and wheat and are highly prized for pecan trees. Large native pecan trees on Frio soils have produced as much as 800 pounds of nuts per tree in favorable years.

Frio clay loam, 0 to 1 percent slopes (FcA).—This soil occupies nearly level areas on the flood plains of the San Saba River and the large creeks of the county. It has a profile like the one described for the Frio series. Slow-moving, shallow floodwaters cover this soil about once in 15 years. Areas of this soil range from 25 to 300 acres in size.

Included with this soil in mapping are a few small areas of Dev soils. Also included are a few areas that are flooded frequently and small areas that have slopes of as much as 2 percent.

This is one of the best soils for farming in Menard County. It is well suited to all crops commonly grown, especially native and improved pecans. It is well suited to surface and sprinkler irrigation. (Capability unit IIc–1 (dryland), I–1 (irrigated); Bottom-land range site)

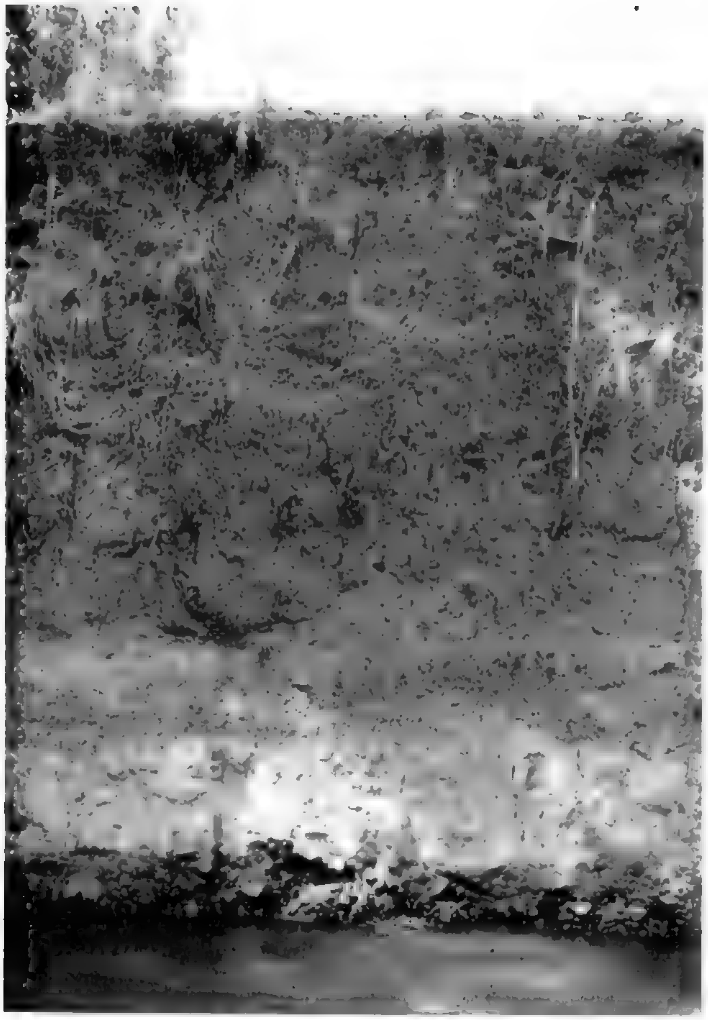

Figure 6.—**Profile of Frio clay loam. A bed of gravel is just above the waterline of the San Saba River. The gravel occurs here at a depth of about 9 feet.**

Frio clay loam, 1 to 2 percent slopes (FcB).—This soil occupies the gently sloping areas on the flood plains of the San Saba River and large creeks of the county. Its profile is like the one described for the Frio series. Slow-moving and shallow floodwaters cover this soil about once in 15 to 30 years.

Included with this soil in mapping are small areas that have slopes of less than 1 percent and small areas that are frequently flooded.

This is one of the better soils in Menard County for farming. It is well suited to all crops commonly grown and to native and improved pecan trees. If it is leveled and smoothed, it is well suited to surface irrigation, but the cost of maintaining an irrigation system is greater on this gently sloping soil than on the nearly level Frio soil. (Capability unit IIe-1 (dryland and irrigated); Bottom-land range site)

Frio soils, frequently flooded (Fr).—These soils occupy the low-lying areas in bends of the San Saba River that are frequently flooded. In most places the surface is uneven and ranges from 1 to 3 feet in elevation within a distance of 50 to 100 feet. Except that it is weakly stratified with thin layers of sand and shell fragments extending to a depth of about 2 feet, the profile of the soils in this mapping unit is like the one described for the Frio series. Floodwaters 10 to 15 feet deep cover most areas of these soils an average of twice each year. Some areas are scoured, and some receive deposits during each flood. In most places the upper few inches of the surface layer consist of material deposited by recent floods. At a depth of 4 to 15 feet, these soils are underlain by water-bearing gravel.

Included with this unit in mapping are small areas of Dev soils.

Frio soils, frequently flooded, are not arable. They support a moderately thick stand of tall pecan trees (fig. 7) and a luxuriant growth of tall grasses. These soils are well suited to wildlife and have good roosting places for wild turkeys. (Capability unit Vw-1 (dryland); Bottom-land range site)

Frio soils, shallow variants (Fs).—These soils occur on the flood plains of creeks throughout the county. In most places the areas are long and narrow and are nearly level to gently sloping. Runoff is slow, and erosion is slight. The areas range from 15 to more than 100 acres in size.

These soils are not so deep as other Frio soils in the county. They range from silty clay loam or clay loam to silty clay. In places the subsoil contains an abundance of limestone cobbles and pebbles. These soils are underlain by limestone bedrock at a depth of 20 to 45 inches, but typically limestone is at about 28 inches. In a few places thin beds of limestone cobbles, stones, and gravel overlie the bedrock. These soils are weakly calcareous in places.

These are good soils for most crops, but use is limited by shallowness. The more sloping areas will erode if left bare or if farmed up and down the slope. Some areas are cultivated, but most of the unit is range. None is irrigated. These soils are not subirrigated like some other Frio soils and are not suited to pecan trees or tall grasses. (Capability unit IIe-1 (dryland); Valley range site)

Hext Series

The Hext series consists of shallow to moderately deep, loamy soils that contain much lime. These brownish soils occur on gentle slopes in the Hext and Saline communities.

The surface layer of Hext soils extends to a depth of about 12 inches and is fine sandy loam that is rich in lime. It has granular structure and contains a few hard pebbles of lime in the upper 8 inches. The subsoil extends to a depth of 19 inches and is brown fine sandy loam that has somewhat blocky structure. It is rich in lime and contains few to many hard pebbles of lime. The substratum extends to a depth of about 50 inches and consists of very pale brown, loamy, limy material that is weakly consolidated. More than half of the material in this layer is lime, and about 20 percent consists of hard pebbles of lime and limestone fragments.

The Hext soils are loose and crumbly and are easily worked. Moisture and roots penetrate readily. Because the content of lime is high, young plants turn yellow. These soils hold only a small amount of moisture and

Figure 7.—Native pecan orchard on Frio soils, frequently flooded. Most orchards of native trees need to be thinned, and competing vegetation needs to be eliminated.

are too droughty for summer crops. Areas of these soils planted to row crops erode unless these areas are terraced and otherwise managed to control erosion.

Most of the acreage of Hext soils is cultivated, but the excessive amount of lime and the small supply of moisture limit yields. These soils are kept under cultivation because they occur in small areas surrounded by deeper soils. Oats, grain sorghum, and forage sorghum are the crops most commonly grown. Some fields are planted to sorghum almum, blue panic, or other short-lived perennial grasses. Most of the native range is in mid grasses of low to medium quality. Mesquite trees, juniper, scrub live oak, tasajillo, and agarita have invaded most areas in range.

Hext fine sandy loam, 2 to 5 percent slopes (HfC).—This soil, the only Hext soil mapped in Menard County, has the profile described for the series. It occurs in areas of 12 to 25 acres.

Included with this soil in mapping are small areas of Brackett soils, of Menard fine sandy loam, and of Karnes loam. Erosion has removed the original surface layer from a few small areas of ¼ to 1 acre. Limestone outcrops and gravelly areas occur and are identified on the soil map by special symbols.

This soil is poor for farming and makes only marginal cropland. It will erode if left bare or unless terraces or other control practices are used in cropped areas. This soil is best suited to winter oats and other winter crops. It is fairly well suited to grass. (Capability unit IVe–1 (dryland); Sandy Loam range site)

Karnes Series

The Karnes series consists of deep, light brownish-gray, crumbly, calcareous soils that occur at the foot of steep slopes in the eastern part of the county.

The surface layer is crumbly loam about 13 inches thick. It is light grayish brown in the upper 8 inches and in the lower 5 inches is pale brown and contains a few streaks of lime. Underlying the surface layer and extending to a depth of about 32 inches, the material is very pale brown and has blocky and granular structure. Streaks, threads, and lumps of lime are common in this

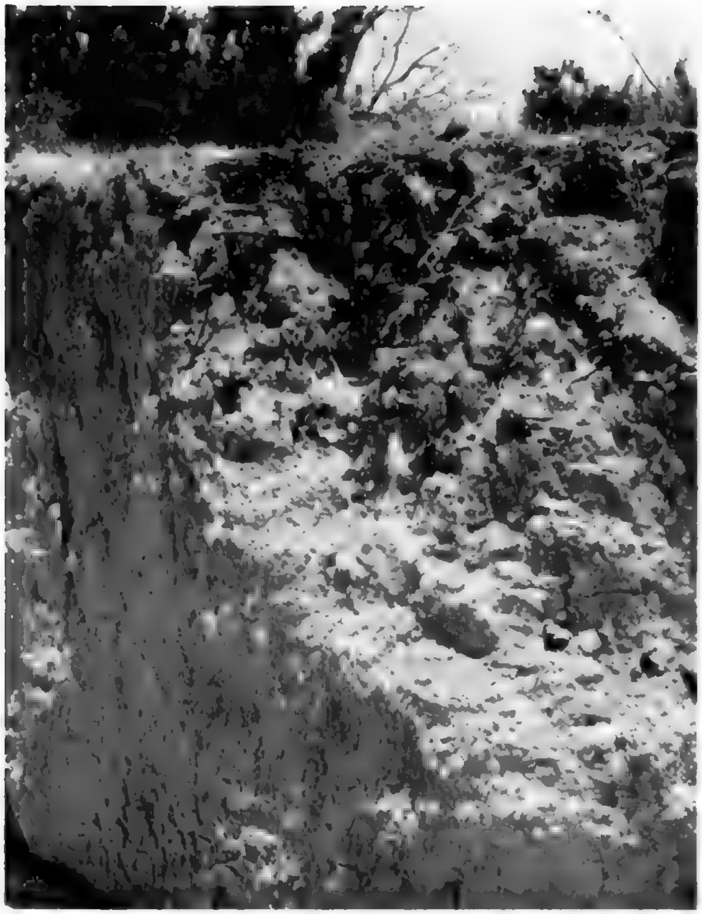

Figure 8. **Profile of Karnes loam, 2 to 5 percent slopes. The light color is characteristic of Karnes soils. Roots have penetrated the soil to a depth of about 5 feet.**

layer. Below a depth of 32 inches is silty clay loam that has granular structure.

The Karnes soils are medium textured and are easily worked. They are loose and crumbly throughout and are easily penetrated by moisture and roots (fig. 8).

These soils contain a small amount of available plant nutrients. Because lime is excessive, young plants turn yellow and their growth is retarded. After each rain a thin crust forms on the surface and increases runoff, but erosion is not severe. Nevertheless, terraces are needed in cultivated fields to control runoff and sheet erosion. Most areas receive some runoff from nearby slopes.

In Menard County about one-fifth of the acreage of Karnes soils is cultivated. These soils are moderately productive when moisture is adequate. Sudangrass, sorghum almum, oats, and wheat are grown for grazing. Karnes soils are well suited to the mid and short range grasses.

Karnes loam, 2 to 5 percent slopes (KnC).—The profile of this soil is the one described for the Karnes series. In most places this soil is bordered at its upper side by the steeply sloping Tarrant-Brackett association, hilly.

Included with this soil in mapping are Uvalde silty clay loam, Brackett soils, and Tarrant soils in areas of less than about 5 acres each. Also included are a few areas that have slopes of less than 2 percent.

This is a fair soil for farming, but its use for tilled crops is limited. It will erode if left bare or unless terraces or other control practices are used in cropped areas. It is suitable for the production of mid and tall native grasses. Areas of this soil in range have 10 to 40 percent of their surface covered by mesquite, juniper, lotebush, condalia, tasajillo, and motts of scrubby live oak. (Capability unit IIIc–2 (dryland); Valley range site)

Kavett Series

The Kavett series consists of gently sloping, dark grayish-brown, shallow soils over limestone. These soils occur throughout the county.

The surface layer, to a depth of about 12 inches, is dark grayish-brown, crumbly, calcareous silty clay. It is somewhat granular in the upper 5 inches but has blocky structure below. The subsoil is dark grayish-brown, crumbly silty clay about 6 inches thick. The lower 2 or 3 inches of this layer contains many limestone cobbles. This layer is abruptly underlain by bedrock at a depth of about 18 inches.

The Kavett soils are crumbly and easily worked. Their fertility is adequate for dryland farming, but good management is needed to maintain fertility and to conserve moisture. Erosion is not excessive anywhere on Kavett soils, but terraces are needed in most places to control runoff and to increase the storage of moisture. Kavett soils hold a medium amount of moisture and have medium fertility.

Most areas of the Kavett soils are in range, but about 20 percent of the acreage is cultivated. The soils are well suited to the cool-season crops, oats, and wheat. Most widely grown are oats used for grazing. Kavett soils are not irrigated.

Kavett silty clay, 0 to 3 percent slopes (KaB).—This is the only soil in the Kavett series mapped in the county. Its profile is the one described for the Kavett series. This soil occurs in areas of 50 to 100 acres.

Included with this soil in mapping are small areas of Tarrant soils, undulating, of Tobosa clay, of Knippa clay, and of Mereta clay loam. Also included are areas of Dev soils along small streams. A few included areas have slopes of more than 3 percent.

This is a fairly good soil for farming. The more sloping areas will erode if left bare or if farmed up and down the slope. It is easily worked and produces favorable yields of small grain. Because it is shallow, it is of limited use for summer crops. (Capability unit IIIe—3 (dryland); Shallow range site)

Knippa Series

The Knippa series consists of deep, dark, nearly level to gently sloping silty clays on stream terraces throughout the county. In most areas the soils crack deeply on drying.

The surface layer, to a depth of about 15 inches, is dark grayish-brown silty clay that contains much lime. It has granular structure to the depth normally plowed but is blocky below that depth. The subsoil extends to

a depth of about 32 inches and is brown silty clay that has fine, blocky structure. The substratum is pinkish silty clay that contains much lime. Soft lumps and threads of lime are common throughout.

The Knippa soils are easy to plow, for they are fairly crumbly in the upper few inches. They are firm below plow depth. Fertility is adequate for dryland farming, but phosphate and nitrogen fertilizers are needed for irrigated crops. Knippa soils have high moisture-holding capacity and, during wet years, contain a large amount of moisture that plants can use. Erosion is slight, but terraces are needed in sloping areas to prevent runoff and erosion and to increase the storage of moisture.

About one-fourth of the acreage of Knippa soils is cultivated, and a small acreage is irrigated. The soils are well suited to oats, wheat, and sorghum. Most widely grown are oats used for winter and spring grazing. Under irrigation, Knippa soils are well suited to cotton, corn, alfalfa, and pecan orchards. Much of the cultivated acreage has been planted to sorghum almum, blue panic, and similar grasses.

Knippa silty clay, 0 to 2 percent slopes (KpA).—This is the only soil in the Knippa series mapped in Menard County. Its profile is like the one described for the Knippa series.

Included with this soil in mapping are small areas of soils, mainly Frio and Uvalde, that have a clay loam or silty clay loam surface layer. Also included are small areas of Dev soils, Valera silty clay, of Tobosa clay, and of Mereta clay loam.

This is a good soil for farming. The more sloping areas will erode if left bare or if farmed up and down the slope. If irrigated, it produces favorable yields of pecans and alfalfa. (Capability unit III-1 (dryland), IIe-1 (irrigated); Valley range site)

Menard Series

The Menard series consists of loamy soils that have a reddish clay loam subsoil over limy material (fig. 9). The soils occur in the Hext and Saline communities.

In undisturbed areas the surface layer extends to a depth of about 8 inches and consists of dark-brown fine sandy loam that is free of lime. It is friable and has granular structure. In cultivated fields the surface layer is grayish brown to the depth normally plowed. The subsoil extends to a depth of about 40 inches and consists of sandy clay loam that has blocky structure. In the upper 6 inches, the subsoil is reddish brown, very firm, and free of lime. It is yellowish red between depths of 14 and 31 inches, but between 31 and 40 inches it is brown and contains free lime in the form of seams and threads. The substratum is pink sandy loam that is friable, porous, and limy.

Menard soils are loose and easily worked. Productivity is low in cultivated fields. Gully erosion is not serious, but sheet erosion has removed much of the original surface soil. The capacity of these soils to hold moisture is medium.

Most areas of Menard soils are cultivated, but in recent years many fields have been planted to sorghum almum, blue panic, and similar grasses. These soils can be used for grain sorghum, corn, oats, and hay crops, but production is low, except in years when rainfall is above average. Menard soils are highly valued for peach orchards.

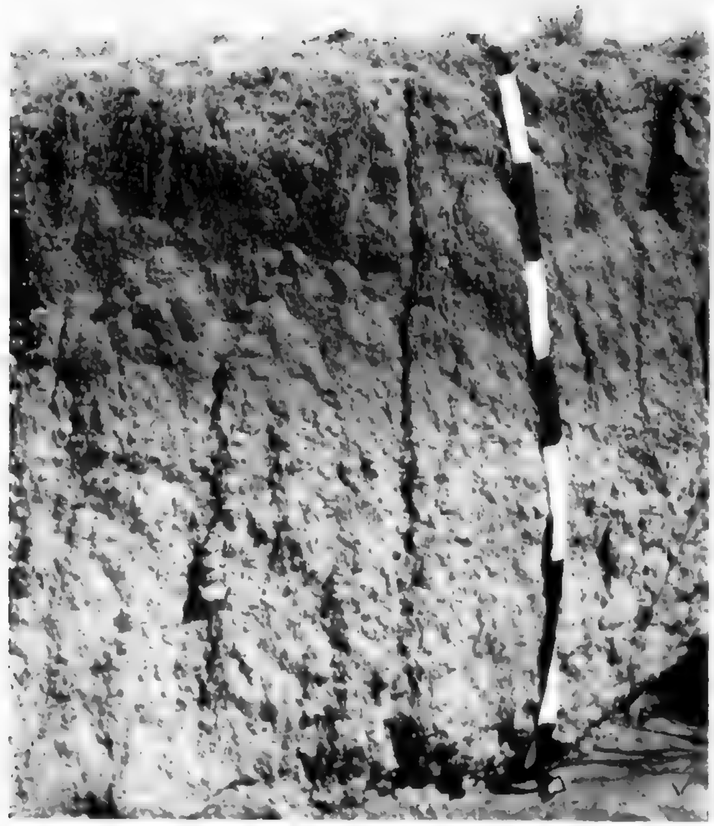

Figure 9.—**Profile of Menard fine sandy loam. The substratum is about 40 inches below the surface and contains pebbles and lumps of lime.**

Menard fine sandy loam, 1 to 3 percent slopes (MaB).—This soil is like the one described for the Menard series. Slopes are mainly 1 to 2 percent, but in a few small areas, they are as much as 5 percent.

Included with this soil in mapping are small areas of Menard loam, of Stephenville loamy sand, of Nimrod loamy sand, and of Hext fine sandy loam.

This is a fairly good soil for farming. If rainfall is above average, it produces favorable yields of most crops, including fruit. The more sloping areas of this soil will erode if left bare or unless terraces or other control practices are used in cropped areas. This soil is easily worked, and crops on it respond well to good management. (Capability unit IIe-2 (dryland); Sandy Loam range site)

Menard fine sandy loam, 3 to 5 percent slopes (MaC).—This soil is mainly on slopes of about 4 percent. It is of minor extent in the county and occurs in areas of about 15 to 70 acres. This soil is not so deep as the soil described for the Menard series. The substratum is at a depth of 30 to 45 inches.

This soil is more eroded and less productive than Menard fine sandy loam, 1 to 3 percent slopes. Surface runoff is medium, and the erosion hazard is moderate.

Sheet erosion has occurred over the entire area, and several small areas are badly gullied.

Included with this soil in mapping are small areas of Hext fine sandy loam and of Stephenville loamy sand. Also included are a few small areas of less than 5 acres each that have slopes of less than 3 percent.

This is a fair soil for farming, but most areas are in abandoned fields that have grown up in annual weeds, grasses, and mesquite trees. Economic yields of most crops and of native grasses can be produced. Response to management is good, but severe erosion is likely unless this soil is protected. (Capability unit IIIe-4 (dryland); Sandy Loam range site)

Menard loam, 0 to 2 percent slopes (MnA). This soil occurs in gently sloping areas in the Hext and Saline communities. The areas are of irregular shape and range from 15 to more than 100 acres in size. Their surface is concave.

The surface layer is very dark brown to dark grayish-brown loam. The subsoil is reddish-brown to dark-brown sandy clay loam.

Included with this soil in mapping are small areas of Menard fine sandy loam, of Hext fine sandy loam, of Frio clay loam, shallow variants, and of Dev soils.

Most areas of this soil are cultivated. The soil is good for farming and is suited to all crops commonly grown, including fruit. The more sloping areas of this soil will erode unless protected. (Capability unit IIe-2 (dryland); Sandy Loam range site)

Mereta Series

The Mereta series consists of shallow, grayish-brown, calcareous soils over cemented caliche. Most areas are north of the San Saba River in gently sloping valleys.

In undisturbed areas the surface layer of Mereta soils is a dark grayish-brown, friable clay loam about 10 inches thick. In cultivated fields it is granular and grayish brown to the depth normally plowed and is blocky below that depth. The subsoil is about 8 inches thick. It is a dark-brown, heavy clay loam that has a few caliche fragments in the lower 2 or 3 inches. It is abruptly underlain by a substratum of pinkish caliche that is hard and platy in the upper 2 or 3 inches and soft in the lower part.

Mereta soils are crumbly and easily worked. They are fertile enough for growing oats and wheat used for grazing. Their moisture-holding capacity is medium. Erosion is slight, but terraces are needed in cultivated areas to control runoff and sheet erosion.

Less than 25 percent of the acreage of Mereta soils is cultivated; none is irrigated. Oats, wheat, and native grasses are well suited. Oats for grazing is the crop most widely grown.

Mereta clay loam, 0 to 2 percent slopes (MrA). This soil, the only Mereta soil mapped in the county, has the profile described for the series.

Included with this soil in mapping are small areas of Tarrant soils, of Uvalde silty clay loam, of Kavett silty clay, and of Terrace escarpments.

This is a fairly good soil for farming. It produces favorable yields of small grain and grain sorghum. It is easily worked. The more sloping areas of this soil will erode unless protected by control practices. (Capability unit IIIe-3 (dryland); Shallow range site)

Nimrod Series

The Nimrod series consists of deep, sandy, nearly level to gently sloping soils in the southeastern corner of the county. The native vegetation consisted of scattered post oak and blackjack oak in a savanna.

The surface layer is loamy sand and extends to a depth of about 18 inches. It is brown, loose, and free of lime in the upper part but is light brown below a depth of about 10 inches. In some cultivated fields the surface layer is compacted below plow depth. The subsoil is a distinctly mottled sandy clay that has blocky structure. The upper 6 inches is brownish yellow with coarse mottles of gray and yellowish red. The lower part is mottled brown, dark-red, and yellowish-gray light sandy clay that, in some places, contains beds of quartz gravel. The substratum is mottled brownish-yellow and red sandy clay loam. It is slightly acid to strongly acid. In some areas quartz gravel occurs within the upper 12 to 20 inches of this soil.

Nimrod soils are loose and easily worked. They have low fertility and are droughty. If left bare through the winter, these soils tend to blow. Water erosion is not a problem, for moisture enters the surface rapidly. But the subsoil takes in water slowly, and during wet seasons excess water is in the lower part of the surface layer. Stripcropping and management of crop residue are needed to control wind erosion. Adding fertilizer and planting soil-improving crops are ways to improve the fertility of cultivated fields and of orchards.

Less than one-fourth of the acreage of Nimrod soils is cultivated. These soils are suited to peanuts, watermelons, and sudangrass. Because all the pastures on these soils have been overgrazed, the grasses that remain are of poor species.

Nimrod loamy sand, 0 to 3 percent slopes (NdB).—This is the only soil of the Nimrod series mapped in Menard County. It occurs on nearly level to gently sloping low ridges in the Saline community. Areas range from 25 to 125 acres in size.

Included with this soil in mapping are small areas of Stephenville loamy sand, and of Menard fine sandy loam.

This soil is only fair for farming. The kinds of suitable crops are few, but good yields of peanuts, watermelons, and other special crops can be produced. This soil blows if it is left bare. (Capability unit IIIe-5 (dryland); Sandy range site)

Rough Broken Land

Rough broken land (Rb) is dominantly on steep, eroded slopes and in narrow, gullied natural drains (fig. 10). It is on breaks along the south side of the San Saba River, about midway between Menard and Hext. The slopes range from 8 to 50 percent but are more than 20 percent in most places. Unstabilized gullies 5 to 10 feet deep and as much as 30 feet wide occur in the natural drains.

In steep areas the surface layer is light-gray, limy clay and chalky earth materials that have been only

Figure 10.—**Rough broken land showing the sparse cover of vegetation and light-colored, eroded areas.**

slightly affected by soil-forming processes. Erosion is active because the sparse cover of grasses and juniper is too thin to prevent washing. On a few steep banks red or gray clay is exposed, and most of the steeper slopes are covered with fossil shells.

Included with this unit in mapping are small areas of Tarrant and Brackett soils. These soils occur on steep slopes, but they are so severely eroded that their original surface layers are very thin or have been completely removed. Also included are shallow, limy, brownish-gray soils at the base of steep slopes and deep, limy, brownish-gray soils in narrow valleys along drainageways.

This is poor land for farming. It produces fair yields of grass that has low nutritive value. (Capability unit VIIe-1 (dryland); Rough Eroded Breaks range site.)

Stephenville Series

The Stephenville series consists of deep, gently sloping, slightly acid soils that have a reddish subsoil. These soils occur in the loamy uplands near the Hext and Saline communities.

The surface layer is grayish-brown loamy sand about 15 inches thick. It is free of lime and has granular structure. In cultivated fields the upper 4 to 6 inches of the surface layer is pale brown. The lower 5 inches or more is dark brown. The subsoil is red to a depth of about 50 inches and is yellowish red in the upper 22 inches. The subsoil is sandy clay loam that has blocky structure and is slightly acid or medium acid. It is friable in the upper part but firm or stiff in the lower part. The substratum is brownish-yellow sandy clay loam that is rich in lime. It is crumbly and contains a few small, hard lumps of lime.

Stephenville soils are loose and easily worked, but they are susceptible to wind erosion. Moisture and plant roots penetrate the subsoil easily. The capacity to hold moisture and plant nutrients is low to moderate.

About one-fourth of the acreage of Stephenville soils is cultivated. Grain sorghum, sudangrass, and oats are the crops most widely grown, but yields are generally low because rainfall is inadequate. These soils are well suited to peaches, peanuts, and melons.

Stephenville loamy sand, 0 to 3 percent slopes (StB).—This soil, the only Stephenville soil mapped in the county, has the profile described for the series. It occurs in gently sloping areas, generally on low ridges. The hazard of wind erosion is slight. Areas range from 10 to about 40 acres in size.

Included with this soil in mapping are small areas of Menard fine sandy loam, or Menard loam, and of Nimrod loamy sand.

This is a fairly good soil for farming. It produces favorable yields of peaches, peanuts, and melons. This soil blows if it is cultivated and left bare. (Capability unit IIIe-5 (dryland); Sandy range site)

Tarrant Series

The Tarrant series consists of dark-colored, very thin soils over hard limestone. These soils occur throughout Menard County and make up about 75 percent of the total area.

The surface layer of Tarrant soils is typically very dark grayish-brown clay about 6 inches thick. It contains much lime and some limestone gravel. In some places coarse limestone gravel, cobbles, stones, and flags are scattered over the surface. Below the surface layer is a 2- or 3-inch layer of which about 85 percent is limestone fragments, gravel, and stones and about 15 percent is soil material. The substratum is hard limestone that is fractured in most places in the upper few inches but may be soft, massive, and porous below.

Because Tarrant soils are shallow, they can produce only low yields of cultivated crops. They produce nutritious grasses and forbs, however, and are highly regarded as range. Small areas of these shallow soils commonly occur in cultivated fields among deeper soils. These areas produce some grass for grazing, but they erode if they are cultivated along with the deeper soils. These soils are used mainly for the grazing of cattle, sheep, and goats.

Tarrant soils, undulating (Ta).—This mapping unit occurs throughout the county in the gently sloping to sloping limestone uplands. Slopes range from 0 to 8 percent, but dominantly they are 1 to 6 percent. Runoff during heavy or extended rains is rapid, and the soils are slightly eroded. All the acreage is in native grass. About 36 percent of this unit does not have limestone fragments on the surface or in the solum. About 27 percent of the unit is cobbly; the rest is channery, stony, flaggy, gravelly, or cherty. Limestone bedrock crops out in places.

Included with this unit in mapping are small areas of Valera silty clay, of Kavett silty clay, of Knippa silty clay, of Dev soils, of Brackett soils, and of Uvalde silty clay loam.

The soils in this mapping unit are too shallow for cultivation. They make good range that is suitable for grazing

all kinds of livestock common in the area. (Capability unit VIs-1 (dryland); Low Stony Hills range site)

Tarrant-Brackett association, hilly (Tb).—This mapping unit occurs on steep slopes between the limestone uplands and the lower lying areas in the valley of the San Saba River and in the Central Basin. Slopes range from about 8 to 20 percent. Tarrant soils make up 50 to 80 percent of most areas, Brackett soils 10 to 50 percent, and other soils the rest. The Tarrant soils occupy the upper parts of the slopes, and the Brackett soils occupy the lower part. Erosion is slight or moderate. Areas of this mapping unit are long and narrow and are several hundred acres in size. All of the acreage is used for range.

The profile of the Tarrant soils is similar to the one described for the Tarrant series, but typically it is only about 4 inches thick. Because slopes are steep, runoff is rapid and the soil is less productive than the less sloping Tarrant soils.

The profile of the Brackett soils is more gravelly than the one described for the Brackett series. Also, the Brackett soils in this unit are covered with soft, fine, fragments of limestone in most places. Surface crusting is severe, and runoff is rapid where the soil is bare.

Included in this mapping unit are areas where clayey, geologic materials and narrow bands of geologic sands are exposed. Limestone scarps and boulders are common on the higher and steeper slopes. Also included are small areas of Rough broken land.

The soils in this mapping unit are poor for farming, but a good cover of grass can be grown, and areas are valuable as a wildlife habitat. (Both soils, capability unit VIs-2 (dryland); Tarrant soils, Low Stony Hills range site; Brackett soils, Adobe range site)

Tarrant-Kavett complex, nearly level (Tk).—This complex of soils occurs in nearly level to gently sloping valleys and on gently sloping hills, mainly in the northwestern part of the county. Areas of these soils are so small and so intricately intermingled that separation is impractical on a soil map of the scale used. Tarrant soils make up 60 to 80 percent of most areas. In many of the larger areas, the Kavett soils occur in small rounded areas that are surrounded by Tarrant soils.

In most places these Tarrant soils are slightly lighter colored than Tarrant soils, undulating. The upper part of the underlying material ranges from hard limestone to a bed of limestone cobbles or flags.

Included in this mapping unit are small areas of Valera clay, of Knippa clay, of Brackett gravelly loam, of Mereta clay loam, and of Dev soils.

All the acreage of this complex is range, but the range generally is only fair. The Tarrant soils of this complex are somewhat more likely to crust and are more limy than Tarrant soils in other mapping units. Many areas need reseeding to establish a good cover of grass. Mesquite trees and other woody plants have invaded most areas and need to be eradicated before reseeding. (Both soils, capability unit VIs-1 (dryland); Tarrant soils, Low Stony Hills range site; Kavett soils, Shallow range site)

Terrace Escarpments

Terrace escarpments (Tr) consists of long, narrow areas of gravelly breaks between the bottom lands and uplands. These areas border the bottom lands of the San Saba River and large creeks in the county. Slopes are short and range from 2 to 20 percent. Gravel and stones cover much of the surface. The soil material is pinkish and is about 50 percent gravel (fig. 11), but in some areas no gravel or stones are within a foot of the surface.

Figure 11.—**Roadside cut in Terrace escarpments. Gravel makes up about 50 percent of the mass.**

Because this land type contains much gravel and is steep, it is not suitable for cultivation. Much of the area is in small pastures that have only a sparse cover of vegetation but are heavily grazed. Three-awn, Texas grama, and annuals are the typical grazing plants, but also present are mesquite, lotebush, condalia, agarita, and a few live oak trees. The live oak trees grow singly or in motts.

Although erosion is slight in most areas, a better cover of grass is needed on the steep slopes to reduce sheet erosion. Most areas of this land type are suitable for gravel mining, and gravel pits have been dug in a few areas. (Capability unit VIs-3 (dryland); Rough Eroded Breaks range site.)

Tobosa Series

The Tobosa series consists of deep, dark grayish-brown, nearly level to gently sloping soils in shallow valleys in the southeastern part of the county. The most extensive areas are in the Hext and Saline communities.

The surface layer of these soils extends to a depth of about 30 inches and consists of dark grayish-brown

clay that has blocky structure and contains much lime. The upper part, or the normally plowed layer, crumbles readily after rains. This layer cracks deeply as it dries. Underlying the surface layer, and extending to a depth of about 50 inches, is grayish-brown blocky clay that is high in lime. The lower 5 inches is pale brown and has streaks and specks of lime. This layer is underlain by limestone that is hard and fractured.

Because the Tobosa soils have heavy clay texture, they are somewhat difficult to work. They take in water slowly and are slowly drained in nearly level areas. They have a high capacity to hold moisture and high fertility. None of the areas is badly eroded, but terraces are needed in sloping areas to control runoff and erosion.

Tobosa soils are fertile and productive, but above-average rainfall is required for favorable crop yields. The soils are well suited to oats, wheat, cotton, and grain sorghum. About half of the acreage of Tobosa soils is planted to sorghum almum, blue panic, and other temporary grasses.

Tobosa clay, 0 to 1 percent slopes (TsA).—This soil has a profile like the one described for the Tobosa series. It is nearly level and receives runoff from surrounding higher soils. Most areas of this soil are near the southeastern corner of the county north of Erna. These areas are in native grasses. Runoff is slow, and most of the ainfall is absorbed. Erosion is slight.

Included with this soil in mapping are small areas of Knippa soils and of Valera soils. It is one of the most fertile soils in Menard County, but crop yields are limited by the low rainfall in all but the wetter years. This is the most difficult soil in the county to work. (Capability unit IIIs-1 (dryland); Valley range site)

Tobosa clay, 1 to 3 percent slopes (TsB).—This soil occurs in gently sloping areas in valleys. The largest areas are near Hext. The profile of this soil is like the one described for the Tobosa series.

Included with this soil in mapping are small areas of Valera silty clay, of Tarrant soils, of Knippa silty clay, and of Uvalde silty clay loam.

This soil is fertile and is cultivated in most areas. Working the soil is difficult, and crop yields are limited by the low rainfall in all but the wetter years. Unless cultivated areas of this soil are protected, they will erode and become gullied. (Capability unit IIIe-1 (dryland); Valley range site)

Uvalde Series

The Uvalde series consists of deep, crumbly, nearly level to gently sloping soils on stream terraces. These soils occur throughout the county.

The surface layer is about 22 inches of silty clay loam that contains much lime and is easy to work. It is dark grayish brown in the upper 14 inches and is brown in the lower 8 inches. This layer has granular structure to the depth normally plowed but has blocky structure below that depth. The subsoil extends to a depth of about 32 inches and, like the surface layer, is silty clay loam. It is light brown in color and subangular blocky in structure. The substratum is pinkish, limy material (fig. 12). In places the substratum is cemented in the upper 1 or 2 inches, but the cementation is not so strong that it restricts the penetration of roots or moisture. In the upper 6 to 18 inches, the substratum contains many small concretions of lime.

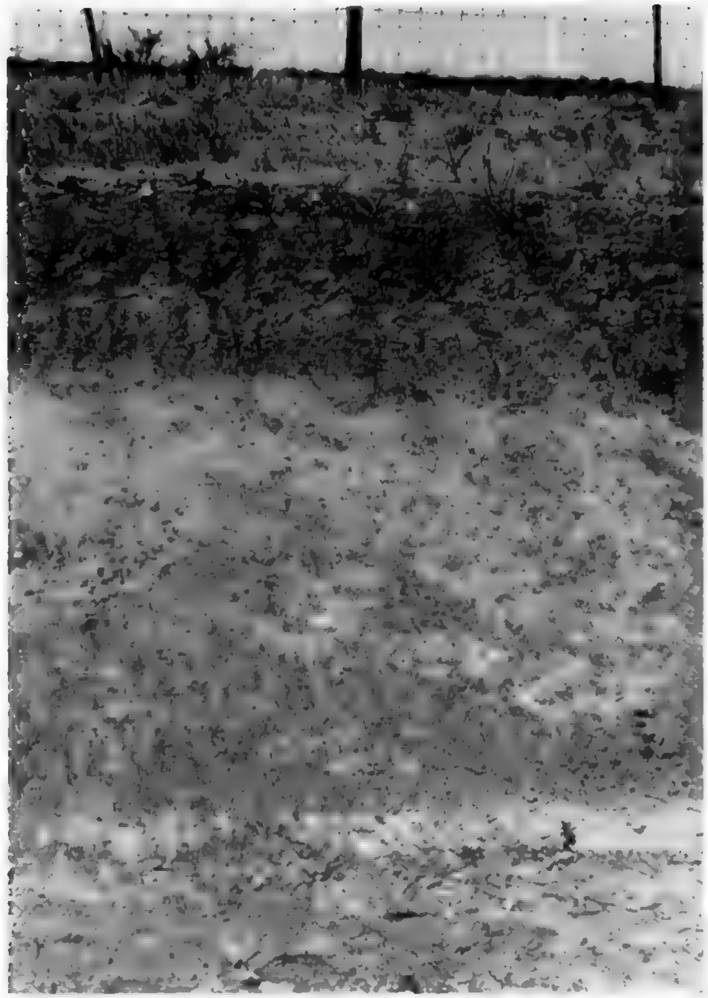

Figure 12.—**Profile of Uvalde silty clay loam. The soil is about 28 inches deep. Its light-colored substratum extends to the bottom of the road cut, which is about 6 feet.**

Uvalde soils are loose and crumbly throughout, and they permit deep penetration of moisture and roots. Fertility is adequate for dryland farming, but fertilizer is needed in irrigated areas. Erosion is not excessive on the Uvalde soils, but terraces and contour cultivation are needed to control runoff and increase the storage of moisture.

Less than one-fourth of the acreage of Uvalde soils is cultivated, and a small acreage is irrigated. The soils are well suited to oats, wheat, and grain sorghum. Oats for winter grazing is the crop most widely grown. Recently much of the acreage of Uvalde soils has been planted to sorghum almum, blue panic, and similar grasses. Where a permanent supply of irrigation water is available, the Uvalde soils are suitable for pecan orchards.

Uvalde silty clay loam, 0 to 1 percent slopes (UaA).—This soil generally occurs on the broad terraces along the

San Saba River and larger creeks in the county. Areas range from 20 to 40 acres in size. The profile of this soil is like the one described for the Uvalde series.

Included with this soil in mapping are a few small areas of Knippa silty clay, of Mereta silty clay loam, and of Frio silty clay loam. Also included are a few small areas that have slopes of as much as 3 percent.

This is a good soil for farming, but most areas are in range. It is fairly fertile and is easy to till. Runoff is slow and erosion is slight. Because this nearly level soil has a smooth surface, it is well suited to irrigation where water is available. It is suited to all irrigated crops commonly grown, including pecans. (Capability unit IIc-1 (dryland), I-1 (irrigated); Valley range site)

Uvalde silty clay loam, 1 to 3 percent slopes (UaB).—This soil occurs throughout the county on the terraces along large and small streams. Most areas are small, but several large areas occur in the valley of the San Saba River. Except for the slightly thinner surface layer and subsoil, this soil has a profile similar to the one described for the Uvalde series. Lime has accumulated at a depth of 18 to 27 inches, or a few inches nearer the surface than in Uvalde silty clay loam, 0 to 1 percent slopes.

Included with this soil in mapping are small areas that have slopes of less than 1 percent. Also included are small areas of Knippa clay and of Mereta silty clay loam.

This is a good soil for farming, but less than one-fourth of the acreage is cultivated. In areas where the slope is 2 percent or more, this soil will erode unless protected by control practices. It is easy to work, fairly fertile, and well suited to dryland crops, especially small grain. (Capability unit IIe-1 (dryland and irrigated); Valley range site)

Valera Series

The Valera series consists of dark grayish-brown, moderately deep, crumbly soils over hard caliche. These soils occur throughout the county on gentle slopes of the shallow valleys and the limestone uplands.

The surface layer extends to a depth of about 5 inches and is very dark grayish-brown silty clay that contains a few fragments of limestone. A few fragments of limestone are also on the surface. Dark-brown, blocky but crumbly clay extends from the surface layer to a depth of about 19 inches. This layer contains free lime. Between depths of about 19 and 27 inches, the subsoil is brown, subangular blocky, crumbly silty clay loam that contains much lime. In many places the substratum consists of a bed of limestone rubble and pink silty clay loam that is as much as 3 feet thick in some places. The upper few inches of the substratum is cemented. Limestone cobbles, flags, and pebbles make up as much as 90 percent of the substratum. Limestone bedrock occurs at a depth of about 50 inches.

Valera soils are loose and crumbly throughout and permit easy penetration of moisture and roots. Fertility is adequate for dryland farming. Except for a few small gullied areas, erosion is slight. Terraces are needed in most fields to control runoff and increase the storage of moisture.

Not more than one-fourth of the acreage of Valera soils is cultivated. These soils are suitable for small grain and grain sorghum. Oats for winter grazing is the crop most widely grown. Most areas receive some runoff from higher soils. Many fields have a volunteer stand of johnsongrass that provides summer grazing where oats are grown for winter grazing.

Valera silty clay, 0 to 3 percent slopes (VaB).—This soil, the only soil of the Valera series mapped in Menard County, has the profile described for the Valera series. It occurs in areas that are 15 acres to several hundred acres in size.

Included with this soil in mapping are small areas of Knippa silty clay, of Kavett silty clay, of Tarrant soils, of Tobosa clay, and of Dev soils. Also included are areas of Valera soils that have a stony clay surface layer. The areas of stony clay and areas of rock outcrops are identified on the soil map by special symbols.

This is a good soil for farming. It is easy to work, fertile, and well suited to all the major crops grown in the county. In areas where the slope is 2 percent or more, this soil will erode unless protected by control practices. Many areas receive runoff from higher soils. (Capability unit IIe-1 (dryland and irrigated); Valley range site)

Use and Management of Soils

The soils of Menard County are used mostly for range and, to a smaller extent, for crops. This section explains how the soils can be used for those purposes and also for providing wildlife habitats and for building highways, farm ponds, and other engineering structures.

Managing Soils for Range [2]

About 562,900 acres, or 96 percent of the county, is rangeland. This rangeland consists mostly of gently undulating soils that were derived from limestone in the northeastern part of the Edwards Plateau Land Resource Area. The rest of the rangeland consists of loamy soils in the Central Basin Land Resource Area in the southeastern part of the county. In this area the rangeland amounts to about 12,000 acres.

In most places on the Edwards Plateau, the soils are very shallow over hard limestone, but deeper soils occur in the valleys, on flood plains, and on the lower lying uplands. The San Saba River and its tributaries drain this area. This river enters the county on the west and flows out on the east.

The economy of Menard County is based on income from the sale of sheep, cattle, and goats. These animals have available a wide variety of grazing because the climate is favorable for the growth of many kinds of plants, including much browse. On many ranches all three kinds of livestock are raised. Sheep amount to the largest number of animal units in the county, cattle the next largest, and goats the smallest. An animal unit is one cow, one horse, five sheep, or five goats; it is approximately equivalent to 1,000 pounds of live weight.

Some of the rangeland in the county, especially that along the San Saba River, has been grazed since the

[2] By THAD B. TREW, range conservationist, Soil Conservation Service.

Spaniards established the first mission in 1757. The first grazing of the area by domestic animals started about 1850, when the pioneers settled permanently. From that time, the numbers of livestock increased steadily. The largest numbers were raised in the period between 1890 and 1930. During this period, grazing was heavy and the range deteriorated. In the 1880's drought also played a part in the deterioration of range. Bluestem, sideoats grama, and other of the better grasses were replaced by brushy and other less desirable plants. Today many areas are almost void of the original mid grasses.

The vegetation on rangeland grows most during two definite periods. During April, May, and June, or roughly in spring, approximately two-thirds of the annual growth of forage plants is produced. In this period rainfall is heaviest, and the temperature is most favorable for the growth of warm-season plants. The other period of growth is during September and October. In this period rainfall is not so heavy nor so dependable as it is in spring, and the cooler temperatures in the latter part of October retard the growth of warm-season plants. In January the growth of all forage plants is retarded by low temperatures. Short droughts are common in midsummer and often last from 60 to 90 days.

Range sites and condition classes

Range sites are distinctive kinds of rangeland that have different potentials for producing native forage plants. The range sites in areas having similar climate differ only in the kind or amount of vegetation they can produce. The differences are the result of different soil characteristics. These characteristics are depth, texture, structure, position, and, to a lesser extent, exposure and elevation.

The kind and amount of vegetation produced on a site depend on the fertility and aeration of the soil and the amount of water that is taken in and retained for plant use. A range site on bottom lands consists of deep, fertile soils that receive water from floods in addition to the normal rainfall. Consequently, on range sites of this kind, grasses grow taller and in greater amounts than they do on upland sites or on shallow sites that receive less water.

Grass, like all other plants, manufactures its food in its green leaves and tender stems. Much of the food is stored in underground roots and buds for the use of shoots that emerge the following year. If the plants are grazed too short, the manufacture and storage of food are limited and the plants that survive are weak and sparse. Thus, the continued growth and production of range plants are directly affected by the amount of grazing the range receives. Heavy grazing or overgrazing reduces or destroys the leaf and stem surface and thus reduces the amount of food produced by the plant for its maintenance and growth. If overgrazing is continued for several successive years, many plants are killed. The most palatable and nutritious plants are grazed most by animals and therefore are first damaged or destroyed.

The palatable plants decrease under continued grazing and are called *decreasers*. The less desirable plants are left to grow and increase in density. They are called *increasers*. As overgrazing continues, the increasers are weakened and destroyed. Plants foreign to the site then invade and inhabit the site. They are called *invaders*.

By this process the range site changes in composition of vegetation from the best plants to the poorest. These successive changes are referred to by ranchers as range condition. The vegetation on range sites is commonly classified in *range condition classes* by comparing the present plant cover with the original cover for the site. If 76 percent or more of the present cover consists of the original plants, the range is in *excellent* condition; if the percentage is 51 to 75, it is in *good* condition; if the percentage is 26 to 50, it is in *fair* condition; and if the percentage is less than 25, it is in *poor* condition.

Although a pasture is generally made up of several range sites, usually one site receives grazing preference. This is the key site, and it can be used as a basis for managing and evaluating the grazing use of the entire pasture. If the key site is managed correctly, the rest of the pasture will improve.

Descriptions of range sites

In the following pages the eight range sites in Menard County are described, and the principal decreasers, increasers, and invaders are listed. The predicted yield of total herbage is given for each site when it is in excellent range condition. No herbage from woody plants is included in predicted yields.

LOW STONY HILLS RANGE SITE

This site is a savanna on gently rolling stony hills in which live oak or shin oak is scattered. It covers 412,121 acres, or 70.4 percent, of the county. A typical area of this site is the low hills south of Menard (fig. 13).

In this site are very shallow, stony or gravelly clay underlain by fractured limestone. The cracks in the underlying limestone contain some soil material that is easily penetrated by roots and water. Because of these cracks and because of the soil material between the rocks, the soils of this site have good moisture-holding capacity. Soil crusting is not a problem on this site. During the winter and in dry periods, the forage contains only a small amount of phosphorus.

Decreasers make up about 75 percent of the original, or climax vegetation, and increasers make up the rest. The principal decreasers are sideoats grama and little bluestem. Buffalograss, curly mesquite, Texas wintergrass, and slim tridens are the principal increasers. Live oak and Bigelow oak may shade about 10 percent of the area. The common decreasers, increasers, and invaders are in the following lists:

Decreasers	*Increasers*	*Invaders*
Sideoats grama.	Texas wintergrass.	Hairy tridens.
Little bluestem.	Buffalograss.	Red grama.
Cane bluestem.	Curly mesquite.	Purple three-awn
Silver bluestem.	Slim tridens.	Mealycup sage.
Green sprangeltop.	Hairy grama.	Pricklypear.
Hairy dropseed.	Orange zexmania.	Tasajillo.
Texas cupgrass.	Indian mallow.	Tumblegrass.
Canada wildrye.	Live oak.	Agarito.
Engelmanndaisy.	Bigelow oak.	
Perennial legumes.		
Mexican sagewort.		

For several years the trend in range condition on this site has been downward. Late in the 1940's, several areas were in good condition, but in the past 16 years, 10 years have been droughty. This droughtiness, cou-

Figure 13.—Top: **Low Stony Hills range site on Tarrant soils. The range is in fair condition. The main grasses are buffalograss, sideoats grama, and slim tridens. Pricklypear has started to invade the site. *Bottom:* This Low Stony Hills range site has been deferred from grazing. The better grasses on Tarrant soils are coming back and crowding out the less desirable plants.**

pled with overgrazing, has left most range vegetation on this site in poor or fair condition. The first decreasers to be eliminated were bluestem, green sprangletop, Texas cupgrass, and hairy dropseed. Most of these decreasers were grazed by cattle. Heavy grazing by goats and sheep reduced or eliminated skunkbush sumac, kidneywort, Englemanndaisy, Mexican sagewort, perennial legumes, and other desirable plants. Some of the oaks were also eliminated by the heavy grazing of goats, and the rest of the oaks have a high browse line. Few fires have occurred on this site in recent years.

Except in the steeper areas that have large stones, grasses on the Tarrant soils in this site respond well to range seeding, brush control, and other management practices.

When this site is in excellent condition, it annually produces 3,000 to 4,000 pounds of air-dry herbage per acre.

VALLEY RANGE SITE

This site occurs in narrow valleys, on gently sloping uplands, and on high terraces along major streams. It occupies 63,832 acres, or 10.9 percent of the county. A typical area of this site is along State Route 29 about 7.0 miles west of Menard.

The soils in this site are deep, dark, fine textured, and slowly permeable to moderately permeable. They contain a large amount of lime that combines with the phosphorus and makes it only slowly available to plants. Consequently, the forage on the site is low in phosphorus at certain times of the year.

In most places this site is downslope from the Low Stony Hills range site and receives from that site extra water as runoff. Because of this extra water, the Valley range site is one of the higher producing range sites in the county. It recovers quickly after periods of drought. The soils on this site, however, dry out during dry periods that last 60 to 90 days, and the plants become dormant. Only those plants that can resume growth following frequent periods of dormancy are able to survive. Little bluestem, big bluestem, and indiangrass do not grow on this site, because they have been unable to withstand the periods of drought. The soils in this site are susceptible to crusting, which limits their intake of water.

Decreasers make up about 70 percent of the original, or climax, vegetation, and increasers make up the rest. The principal decreasers are sideoats grama, cane bluestem, pinhole bluestem, and silver bluestem. Buffalograss, curly mesquite, Texas wintergrass, and vine-mesquite are the principal increasers. Few, if any, trees grow on this site, but mesquite is a common invader. The common decreasers, increasers, and invaders are given in the lists that follow:

Decreasers	*Increasers*	*Invaders*
Sideoats grama.	Buffalograss.	Purple three-awn.
Cane bluestem.	Curly mesquite.	Red three-awn.
Pinhole bluestem.	Texas wintergrass.	Red grama.
Texas cupgrass.	Vine-mesquite.	Mesquite.
Canada wildrye.	Orange zexmania.	Pricklypear.
Engelmanndaisy.		Texas grama.
Bushsunflower.		Western ragweed.
Mexican sagewort.		Prairie coneflower.
Perennial legumes.		Agarito.
		Condalia.

This site was one of the first in the county to deteriorate under heavy grazing by livestock. Because no brush grows, the site is generally preferred by animals for grazing and for traveling from one part of a range to another. All of the decreasers were quickly grazed from this site, and the only increasers left were the short buffalograss, curly mesquite, and Texas wintergrass. The invaders were numerous. Deterioration would have been worse if the soils on this site had not received extra water from the surrounding higher soils. The abuse was mostly by sheep and cattle, for goats do not graze this site so much as they graze others. Because flies are fewer than on other sites, cattle congregate on this site

in summer. Fires have not been a factor in the deterioration of this site. In most places the site is in poor or fair condition.

Grasses on the Uvalde, Valera, and Knippa soils in this site respond most readily to proper use and deferred grazing.

When this site is in excellent condition, its total annual production ranges from 5,000 to 6,000 pounds of air-dry herbage per acre.

SHALLOW RANGE SITE

This site occupies gentle slopes in the uplands. In many places it occurs as a transitional area between the Low Stony Hills and Valley range sites. It occupies 57,861 acres, or 9.8 percent of the county. A typical area is 1 mile east of Menard on Ranch Road 42.

The soils in this range site are from 10 to 24 inches deep. They are dark grayish brown to dark gray or brownish gray. If covered by grass, these soils take in water readily, but they are susceptible to surface crusting when they are bare. Crusting is one of the most serious problems on this site, for it limits the intake of water and slows the recovery of plants. This recovery is further slowed when livestock trample the soils in traveling from one part of a range to another. Varying amounts of rock occur on and in the soils. Also, the soils are too shallow to store rainfall efficiently. For these reasons, this site is droughty and produces little forage. The forage produced is low in phosphorus.

Decreasers make up about 65 percent of the original vegetation, and increasers make up the rest. The principal decreaser is sideoats grama. Buffalograss and curly mesquite are the principal increasers. Scattered live oak trees grow naturally on this site, and agarito and small mesquite trees are the main invaders. The common decreasers, increasers, and invaders are given in the lists that follow:

Decreasers	*Increasers*	*Invaders*
Sideoats grama.	Buffalograss.	Red three-awn.
Cane bluestem.	Curly mesquite.	Purple three-awn.
Silver bluestem.	Slim tridens.	Red grama.
Green sprangeltop.	Texas wintergrass.	Hairy tridens.
Hairy dropseed.	Orange zexmania.	Mealycup sage.
Bushsunflower.	Indian mallow.	Agarito.
Mexican sagewort.		Mesquite.
		Pricklypear.
		Texas grama.

Most of this site is in poor condition. Heavy grazing by cattle and sheep caused most of the deterioration. On ranches that have no areas of the Valley range site, the Shallow range site is used by cattle and sheep in traveling from one part of a range to another. Also, cattle congregate on this site to escape from flies. Heavy grazing and trampling eliminate the decreasers and encourage soil crusting. Crusted areas support a weak stand of buffalograss, curly mesquite, and increasing amounts of agarito and scrubby mesquite. Since grazing began, fires have not influenced the kinds of vegetation that grow on this site.

Grasses on this site respond most readily to brush control, range seeding, and proper use on the soils of the Tarrant-Kavett complex and on Kavett silty clay.

When this site is in excellent condition, its total annual production of air-dry herbage ranges from 2,500 to 3,500 pounds per acre.

BOTTOM-LAND RANGE SITE

This site is in nearly level areas on the flood plains of the major streams. It makes up about 87,717 acres, or 1.5 percent of the county. A typical area of this site is along the San Saba River just north of the town of Menard.

The soils in this site are fertile, deep, and highly productive. They take in water readily and receive extra water from occasional or frequent floods. Also, most areas are underlain at a depth of 9 to 15 feet by gravel that is water bearing in some places. The extra water from these sources increases the productivity of this site. The deeper rooted plants can stand long periods of drought.

The original grasses are scarce on this site because they were grazed off by game animals and by the first livestock, both of which grazed the area and drank from the nearby streams. Pecan trees and a few elms and oaks have shaded and continue to shade about 10 percent of this site. The stands of pecan trees are much thicker than they were.

Decreasers make up about 75 percent of the original vegetation, and increasers make up the rest. The principal decreasers are indiangrass, big bluestem, and switchgrass. Little bluestem grew in the drier areas. The increasers are sideoats grama, Texas wintergrass, silver bluestem, and southwestern bristlegrass. Mesquite and hackberry are the main woody invaders. The common decreasers, increasers, and invaders are given in the following lists:

Decreasers	*Increasers*	*Invaders*
Indiangrass.	Sideoats grama.	Three-awn.
Switchgrass.	Silver bluestem.	Buffalograss.
Big bluestem.	Texas wintergrass.	Hoarhound.
Little bluestem.	Vine-mesquite.	Hackberry.
Canada wildrye.	Southwestern bristlegrass.	Mesquite.
Texas bluegrass.		Western ragweed.
Threeflower melic.	White tridens.	Prairie coneflower.
Engelmanndaisy.	Mexican sagewort.	
Bushsunflower.		
Perennial legumes.		

This site is in poor condition because it has been heavily grazed since the first livestock were brought in. Also, animals from nearby range sites trampled this site when they came in to drink from its streams. Cattle have accounted for most of the early grazing; sheep and goats were introduced later. The tall decreasers—grasses and forbs—have been replaced mainly by Texas wintergrass and Canada wildrye. Also, the stands of pecan, elm, and hackberry are thicker than they were. Before grazing began, fires swept the area and killed all except the larger trees. Heavy grazing and the absence of fire are the main causes for bushy plants and sparse grasses replacing tall, thick grasses.

Grasses on the Frio soils of this range site respond readily to reseeding, proper range use, and deferred grazing.

This site potentially is one of the highest producers of herbage in the county. Range in excellent condition annually produces 7,500 to 8,500 pounds of air-dry herbage per acre.

SANDY LOAM RANGE SITE

This site occurs in gently sloping uplands, mainly in the Hext and Saline communities. Locally it is called

Mixed Land. It occupies 5,000 acres, or 0.8 percent of the county.

The soils in this site are deep or shallow, and they have a sandy loam surface layer over a loam subsoil. Rain infiltrates well into these soils where cover is adequate, and all of the water except some from extremely heavy rains is held by the soils. Because crusting is serious on these soils, their recovery after a drought is slow. The soils in this site have a more favorable balance of minerals than the soils on the nearby Edwards Plateau that are rich in lime. Also, plants are more palatable and more nutritious on this site than those on Edwards Plateau, and they are more preferred by livestock.

Little bluestem is the main decreaser and makes up about 60 percent of the original vegetation. The main increasers, sideoats grama and silver bluestem, make up about 30 percent of a typical area. About 10 percent of this site is shaded by live oak, post oak, and blackjack oak. The oaks have increased in number and now completely cover some areas. In areas where oaks have been removed and grazing has been heavy, mesquite and whitebrush have invaded. The common decreasers, increasers, and invaders are shown in the following lists:

Decreasers	*Increasers*	*Invaders*
Little bluestem.	Sideoats grama.	Three-awn.
Arizona cottontop.	Silver bluestem.	Texas grama.
Plains lovegrass.	Texas wintergrass.	Sand dropseed.
Indiangrass.	Buffalograss.	Hooded windmillgrass.
Sand lovegrass.	Hairy grama.	Nightshade.
Hairy dropseed.		Western ragweed.
Purpletop tridens.		Mesquite.
Canada wildrye.		Whitebrush.
Texas bluegrass.		Tasajillo.
Lovegrass tridens.		Pricklypear.
		Texas persimmon.

This site is in poor condition. Most of it is near cropland. Cattle, sheep, and work animals have grazed this site and have eliminated the decreasers. Much of the post oak has been cut for firewood. Today the site is covered with mesquite, tasajillo, persimmon, three-awn, windmillgrass, and buffalograss. Fires have eliminated most of the brush but have left the large oak trees. Recently, however, there has been no burning. This lack of burning and heavy grazing account for the change in vegetation.

Grasses on the soils of this site respond readily to brush control, range seeding, deferred grazing, and proper use.

When this site is in excellent condition, it annually produces 4,500 to 5,500 pounds of air-dry herbage per acre.

SANDY RANGE SITE

Except for texture, the soils on this range site are similar to those of the Sandy Loam range site. The Sandy range site is mainly in the Saline community. It occupies 400 acres, or about 0.1 percent of the county. A typical area is one-fourth mile southwest of old Erna store.

The soils in this site are deep, and have a brownish, sandy surface layer over a clayey or loamy subsoil. Because their surface layer is sandy, rainfall enters the soil rapidly, and little or none is lost through runoff. Because nearly all of the moisture stored in the surface layer can be used readily by plants, small showers or light rains are effective in encouraging the survival and growth of plants. A good plant cover is needed to reduce high soil temperatures and evaporation.

The variety of vegetation on this site is not so wide as that on the Sandy Loam site, and the stands of post oak are thicker. Because sideoats grama normally does not grow on this site, sand lovegrass becomes more important.

This site is in poor condition because the grazing practices followed are the same bad practices followed on the Sandy Loam range site. A few more post oaks are on the Sandy range site than are on the Sandy Loam range site.

Grasses on the Nimrod soil of the Sandy range site respond best to brush control, but brush control is also needed on the Stephenville soil. On both of these soils, grasses respond well to deferred grazing.

When this site is in excellent condition, it annually produces 4,000 to 5,000 pounds of air-dry herbage per acre.

ADOBE RANGE SITE

This fairly steep site is covered mainly by grasses and a few scattered clumps of Texas, or Spanish, oak. Slopes range from about 8 to 20 percent. This site occupies about 11,200 acres, or 1.9 percent of the county. A typical area of this range site is 6.0 miles east of Menard on farm road 2090, and about 800 feet north.

The soils in this range site are shallow, light colored, and highly calcareous. They are underlain by soft limy clay and soft limestone. In places many fragments of limestone occur throughout the soil. Because they contain much lime and little organic matter, these soils produce only a small amount of forage. The forage produced has a small content of minerals and is less palatable than that on the surrounding Edwards Plateau. Because the content of lime is high, litter does not accumulate. The bunch grasses that grow predominantly on this site are less dense than those on other sites in the county. Because the areas between the bunches of grass are bare and unprotected, erosion is active and there is loss of water. Erosion and loss of water also increase where the soil crusts after the protective cover is destroyed. Erosion on this range site damages the sites below in areas where less productive soil material is deposited.

On the Adobe range site, decreasers make up about 65 percent of the original, or climax, vegetation. Little bluestem covers about 50 percent of the site. The other decreasers are hairy dropseed, sideoats grama and tall grama. Increasers cover about 35 percent of the site and consist of hairy grama, purple three-awn, and silver bluestem. The common decreasers, increasers, and invaders are shown in the following lists:

Decreasers	*Increasers*	*Invaders*
Little bluestem.	Hairy grama.	Hairy tridens.
Hairy dropseed.	Purple three-awn.	Red grama.
Tall grama.	Silver bluestem.	Queen's-delight.
Sideoats grama.	Slim tridens.	Juniper.
Wild alfalfa.	Texas oak.	Mealycup sage.
Bigtop dalea.		Annuals.
Trailing ratany.		

Deterioration has not been so rapid on this range site as it has on others in the county. Some areas are in good condition because their plants are lower in food

value and are not so palatable as the plants on nearby sites. Many of the original grasses are still in the plant composition. Where decreasers make up a small percentage of the plant composition, grazing has been heavy.

Grasses on the Brackett soils respond rapidly to deferred grazing and to proper use. They do not respond well to reseeding, because the surface crusts, erosion is active, and crusty soil material is deposited.

When this site is in excellent condition, it annually produces 1,500 to 2,000 pounds of air-dry herbage per acre.

ROUGH ERODED BREAKS RANGE SITE

This site consists of steep, eroded slopes and narrow, gullied valleys on the limestone uplands and of long, narrow areas of gravelly breaks between bottom lands and uplands. It makes up only 3,930 acres, or about 0.7 percent of the county.

Runoff is rapid, and erosion is active on the upland areas of this site. Little or none of the original surface soil remains, but in the valleys the slopes are protected from gullying by an erosion pavement of gravel. The soil material contains much lime. A good cover of grass is needed to control erosion, evaporation, and soil crusting. On this site revegetation or the recovery of plants is slow. The plant composition on the upland areas is similar to that of the Shallow range site and the Low Stony Hills range site, but the plants are lower in quality because the content of lime in the soil is higher. Some scrubby ash and redberry juniper grow on this site in upland areas. Mesquite trees, agarita, and scattered oak grow on the gravelly breaks in the valleys.

On this range site, decreasers make up about 65 percent of the original vegetation. The most common decreasers are little bluestem, sideoats grama, and silver bluestem. Increasers make up about 35 percent of the original vegetation. The principal increasers are buffalograss and curly mesquite. The common decreasers, increasers, and invaders are given in the following lists:

Decreasers	*Increasers*	*Invaders*
Sideoats grama.	Buffalograss.	Three-awn
Little bluestem.	Curly mesquite.	Hairy tridens.
Tall grama.	Slim tridens.	Red grama.
Hairy dropseed.	Meadow dropseed.	Mealycup sage.
Silver bluestem.		Agarita.
Cane bluestem.		Redberry juniper.
		Mesquite.

Because this site is near the San Saba River, areas were heavily grazed before wells were dug and when the river was the only source of water for livestock. Grazing was heavy because herds were driven across this site to the river and were bedded down overnight. After wells were dug and fences were built, the site was heavily stocked with sheep. The sheep grazed off most of the cover, and deterioration was rapid, because recovery of vegetation was very slow and erosion was severe on the upland areas. Buffalograss, three-awn, red grama, and hairy tridens are the most common plants.

Grasses on this site respond slowly to good management. A recovery program should be followed that permits only limited grazing and that provides for this site to be used mainly as a wildelife habitat. Range seeding is needed in nearly all areas, and long periods of deferred grazing are essential for reestablishing the native grasses.

When this site is in excellent condition, it annually produces 2,000 to 3,000 pounds of air-dry forage per acre.

Managing Soils for Crops

In this subsection the use of cropland in the county is discussed, and the capability classification is explained. For each capability unit in the county, the soils are described and their management suggested. Yields of dryland and irrigated crops are predicted.

Uses of cropland

In Menard County, farming ranks second to ranching and is confined mainly to the valleys and bottom lands. About 22,000 acres is cultivated. Most of the cultivated land is planted to small grain that is used for grazing. Some grain sorghum, sudangrass, cotton, corn, peanuts, and other row crops are grown. Sorghum almum, blue panic, and other grasses are planted in some fields that are taken out of cultivation or rested. Little fertilizer is used under either dryland or irrigated farming.

About 2,200 acres mostly on Frio, Knippa, and Uvalde soils along the San Saba River is surface irrigated. A few areas have been land leveled. Few fields, if any, are fertilized. Good management of soils and water and the proper use of fertilizer are beneficial on irrigated soils.

About 103,000 acres of soils in Menard County is tillable. In some of this acreage the soils are shallow, are not well suited to row crops, and would be more productive if used as range.

Seasonal droughts are common in Menard County, and farmers have learned to expect a good crop only about once in 5 years. Because yields are economically submarginal in the other 4 years, dryland farming for harvested crops is not self supporting. Supplemental grazing, however, is usually profitable because green feed is provided during winter and in dry summers and costly harvesting equipment is not required.

The seasonal droughts and the erosion that is a result of the occasional heavy rains are the main hazards to farming. Practically all the soils in the county are susceptible to these hazards. In addition, wind erosion is a hazard on the sandy soils. In Menard County, the main purpose of management is lessening the effects of drought and erosion by using appropriate practices.

Capability groups of soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I. Soils have few limitations that restrict their use.
Class II. Soils have some limitations that reduce the choice of plants or require moderate conservation practices.
Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.
Class V. Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.
Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.
Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-5. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the arabic numeral specifically identifies the capability unit within each subclass. In the following pages the capability units in Menard County are described and suggestions for the use and management of the soils are given.

Management by capability units

Described in this section are the dryland and irrigated capability units in Menard County. A capability unit is a group of soils about alike in those properties that affect management and similar in response to management. A soil can be in both a dryland capability unit and an irrigated capability unit.

The major practices of management needed on dryland are those that conserve the natural supply of moisture and protect the soils from erosion. On irrigated land, control of erosion is an objective of management, and in addition, the increasing or maintaining of soil fertility and the efficient use of the water available. In good management a cropping sequence is selected that helps to control erosion, that supplies organic matter, that improves the physical condition (or tilth) of the soil, and that helps control insects and disease. A crop that produces much residue, or a grass crop used in the sequence, adds organic matter; a legume adds nitrogen to the soil. Nitrogen fertilizer added to the crop residue hastens its decomposition and provides available nitrogen for the following crop. Crops on irrigated soils respond better to fertilizer than do dry-farmed crops.

CAPABILITY UNIT I-1 (IRRIGATED)

This unit consists of deep, dark grayish-brown, nearly level soils that have a friable subsoil. These soils are fertile, are easily tilled, and have the capacity to hold large amounts of moisture and plant nutrients. The erosion hazard is slight.

On the soils of this unit, the main irrigated crops are oats and wheat, but grain sorghum, cotton, alfalfa, and Coastal bermudagrass are also grown (fig. 14). A few areas are in improved pecan orchards. These soils are well suited to all of these uses.

***Figure 14.*—Irrigated hybrid grain sorghum on Frio silty clay loam, 0 to 1 percent slopes.**

CAPABILITY UNIT IIe-1 (DRYLAND)

This unit consists of deep and moderately deep, dark grayish-brown, gently sloping, fine textured and moderately fine textured soils that have a crumbly subsoil. These soils are fertile, are easily tilled, and have the capacity to hold large amounts of moisture and plant nutrients. The erosion hazard is slight to moderate.

The main crops used in dryland farming are oats and wheat for grazing and for grain, but grain sorghum, cotton, and alfalfa are also grown. All of these crops are well suited to the soils of this unit. Both native and improved pecans are well suited to Frio clay loam, 1 to 2 percent slopes.

CAPABILITY UNIT IIe-1 (IRRIGATED)

This unit consists of deep and moderately deep, dark grayish-brown, gently sloping soils that are fine textured and moderately fine textured and have a crumbly to firm subsoil. These soils are fertile, are easily tilled, and have the capacity to hold large amounts of moisture and plant nutrients. The erosion hazard is slight to moderate.

On the soils of this unit, the main irrigated crops are oats, wheat, and grain sorghum, but cotton, alfalfa, and Coastal bermudagrass are also grown. All of these crops are well suited to these soils.

Practices are needed for controlling erosion. Also needed is land leveling and smoothing so that irrigation water is used efficiently. The lining of irrigation ditches prevents loss of water through seepage.

CAPABILITY UNIT IIe-2 (DRYLAND)

This unit consists of moderately deep, dark-brown, loamy soils that have a reddish or dark-brown subsoil. These soils are gently sloping. They are moderately fertile and are easily tilled. They have the capacity to hold medium amounts of moisture and plant nutrients. Sheet erosion is likely, and gullies form if grassed waterways are not provided.

More than half of the acreage in this unit is cultivated, but none is irrigated. The soils are suited to grain sorghum, sweet sorghum, oats, wheat, corn, cotton, and peach trees. The crops most commonly grown are oats and grain sorghum.

Controlling erosion, conserving moisture, and improving fertility are the principal management practices needed.

CAPABILITY UNIT IIc-1 (DRYLAND)

This unit consists of deep, dark grayish-brown, moderately fine textured soils that have a friable subsoil. These soils are nearly level. They are fertile, are easily tilled, and have the capacity to hold large amounts of moisture and plant nutrients. The erosion hazard is slight.

The main crops used in dryland farming are oats and wheat for grazing and grain, but grain sorghum, cotton, and corn are also grown. These crops are well suited to the soils of this unit. Both native and improved pecans are well suited to Frio clay loam, 0 to 1 percent slopes. If pecans are grown on Uvalde silty clay loam, 0 to 1 percent slopes, irrigation is needed in most places.

CAPABILITY UNIT IIIe-1 (DRYLAND)

This unit consists of deep, dark grayish-brown soils that have a blocky subsoil. These fertile soils occur in gently sloping areas in valleys and on stream terraces. They have the capacity to hold large amounts of moisture and plant nutrients, but their slowly permeable subsoil restricts the movement of moisture and the growth of roots. During years of low rainfall the soils are droughty.

Most of the acreage in this unit is cultivated, and a small acreage is irrigated. The soils are well suited to cotton, grain sorghum, sudangrass, wheat, and oats. Grain sorghum and oats are most commonly grown. Poor tilth is common on these soils if they are poorly managed. The chief management practices needed are those that control erosion, maintain soil tilth and fertility, and conserve moisture.

CAPABILITY UNIT IIIe-2 (DRYLAND)

The soil in this capability unit is deep, light brownish gray, and rich in lime. It occurs on gentle slopes below steep slopes. This soil can hold only moderately small amounts of moisture and plant nutrients. It is easily tilled, friable throughout, and easily penetrated by moisture and plant roots. The hazard of water erosion is slight to moderate.

Little of this soil is cultivated. Oats, grain sorghum, and sudangrass are suitable crops, but young plants may be damaged by the large amount of lime in the soil. The practices needed are mainly those that conserve moisture and control erosion.

CAPABILITY UNIT IIIe-3 (DRYLAND)

This unit consists of shallow, dark grayish-brown, crumbly soils that are moderately fine textured and fine textured. These soils are gently sloping to nearly level. They are fertile, are easily tilled, and have the capacity to hold moderate amounts of moisture and plant nutrients. The erosion hazard is slight.

About one-fifth of the acreage of this unit is cultivated. Oats, wheat, grain sorghum, and sudangrass are suitable crops, but oats for grazing is the crop most commonly grown. The practices needed are mainly those that conserve moisture, maintain fertility, and control erosion.

CAPABILITY UNIT IIIe-4 (DRYLAND)

The soil in this capability unit is moderately deep, is dark brown, and has a reddish subsoil. It occurs on gentle slopes. This soil is permeable to moisture and roots, but it has low fertility. It is easily tilled but is moderately susceptible to erosion.

About half of this soil is cultivated. Oats, grain sorghum, and sudangrass are suitable crops. The practices needed on this soil are mainly those that control erosion, conserve moisture, and maintain fertility and tilth.

CAPABILITY UNIT IIIe 5 (DRYLAND)

This unit consists of deep, grayish-brown, sandy soils that have a reddish or mottled subsoil. These soils are loose, are easily worked, and have the capacity to hold small and medium amounts of moisture and plant nutrients. Their surface layer is rapidly permeable and

quickly soaks up any rain that falls. If these soils are left bare in winter and early in spring, they tend to blow.

More than half the acreage of this unit is cultivated. Peanuts, melons, corn, and peaches are suited and are the main crops grown. Sweet sorghum and other crops that produce a large quantity of residue are well suited.

The practices needed are mainly those that conserve moisture, increase fertility, and control wind erosion. Returning large quantities of crop residue to these soils helps to control wind erosion and to increase fertility. Also helpful in controlling erosion is a cropping sequence that includes tall-growing crops planted in strips. Rye, vetch, and other crops produce cover that is useful in protecting the soils during periods when erosion is most likely.

CAPABILITY UNIT IIIs-1 (DRYLAND)

The soil in this capability unit is deep, dark grayish-brown clay. It occurs in nearly level areas in shallow valleys. This fertile soil can hold large amounts of moisture and plant nutrients, but its slowly permeable subsoil restricts the movement of moisture and the growth of roots. During years of low rainfall the soil is droughty. The erosion hazard is slight.

Little of this soil is cultivated, though it is suited to most crops grown in the county. The main crops are oats and sudangrass for grazing. Practices that maintain good tilth are needed, for poor tilth is common in poorly managed areas.

CAPABILITY UNIT IVe-1 (DRYLAND)

The soil in this capability unit is shallow to moderately deep, brownish, and rich in lime. It occurs on gentle slopes. This soil is readily penetrated by moisture and roots, but it can hold only a small amount of moisture. The erosion hazard is moderate or high unless terraces are constructed and other measures are used to control erosion.

About half of this soil is cultivated. It is not well suited to cultivated crops, but cool-season crops grow fairly well. Oats for grazing and sorghum for hay are the crops most commonly grown. The practices needed are mainly those that improve fertility, conserve moisture, and control erosion.

CAPABILITY UNIT IVe-2 (DRYLAND)

This unit consists of shallow, light-colored, loamy soils that are rich in lime. They occur on gentle slopes. These soils are crumbly, are easily tilled, and have the capacity to hold moderate amounts of plant nutrients and moisture. Surface crusting is severe, and the erosion hazard is moderate.

These soils are not well suited to cultivated crops, but many small areas occur in cultivated fields. Oats for grazing is the crop most commonly grown. Large amounts of crop residue are needed to offset the excessive content of lime in these soils and to increase their capacity to hold moisture.

CAPABILITY UNIT Vw-1 (DRYLAND)

This capability unit consists of deep, dark grayish-brown soils on bottom lands that are frequently flooded and have an uneven surface. Floods may occur several times a year, and they scour some areas and deposit sediments in others. These soils are underlain by water-bearing gravel at a depth of a few feet.

The soils of this unit are best suited to native or improved pecans and to range. Native pecan trees form a thick canopy over most areas. The trees can be kept healthy and productive by thinning, controlling disease, and other good management. If a good cover of grass is maintained, it reduces scouring and helps to keep these soils fertile and productive. The use of these soils for range is discussed under "Bottom-land range site."

CAPABILITY UNIT VIw-1 (DRYLAND)

This capability unit consists of gravelly and stony, frequently flooded soils on bottom lands. Considerable scouring in some places and deposition in other places occur during each flood. Because the content of gravel and stones is large in these soils, they can hold only a small amount of moisture. However, they do receive extra water as runoff from surrounding soils and from floods.

These soils are not cultivated, because they are stony or gravelly and are frequently flooded. They are well suited as range, for they produce fairly large amounts of mid and short grasses. A good grass cover reduces scouring, helps to control evaporation, and keeps the soils productive. The use of these soils for range is discussed under "Valley range site."

CAPABILITY UNIT VIs-1 (DRYLAND)

This unit consists of very shallow, stony or gravelly, fine textured to moderately fine textured soils that are extensive in Menard County. These soils are susceptible to erosion because of the large amount of runoff. They are very shallow or contain many stones, cobbles, and gravel.

These soils are not suited to cultivated crops, but they furnish good year-round grazing if they are managed well. A good cover of grass reduces runoff, erosion, and evaporation. The use of the Tarrant soils for range is discussed under "Low Stony Hills range site;" the use of Kavett soils is discussed under "Shallow range site."

CAPABILITY UNIT VIs-2 (DRYLAND)

This unit consists of very shallow, steep, clayey and loamy soils that are highly susceptible to erosion. Some areas are almost bare.

These soils are not suited to cultivated crops. If they are used as range, careful management is required to maintain enough cover to slow runoff and reduce erosion. A good cover of grass helps to control erosion, to lessen evaporation, and to keep the soils productive of forage. Use of the Tarrant soils in this unit for range is discussed under "Low Stony Hills range site." The use of the Brackett soils is discussed under "Adobe range site."

CAPABILITY UNIT VIs-3 (DRYLAND)

This unit consists of gravelly, steep escarpments that are the breaks between the bottom lands and the stream terraces. Because this land type contains gravel and stones, is steep, and is likely to erode, it is not suited to cultivated crops. If a good cover of grass is maintained, runoff and erosion are controlled, evaporation is lessened, and production of forage is maintained. The use of

Terrace escarpments for range is discused under "Rough Eroded Breaks range site."

CAPABILITY UNIT VIIe-1 (DRYLAND)

In this unit is a land type consisting of steep, severely eroded areas and narrow, gullied natural drains. This land type has very low fertility and a very low capacity to hold moisture and plant nutrients. Because plant cover is sparse, each rain causes erosion.

If areas of this land type in drains are managed well, they produce a good cover, but under the best management, even the eroded areas on steep slopes recover slowly. A grass cover helps in controlling runoff and erosion and in keeping the land productive of forage. The use of this land type for range is discussed under "Rough Eroded Breaks range site."

Moisture conservation and control of erosion

Some of the methods used in managing soils in Menard County are discussed in the following paragraphs.

Sequence of crops.—Among the dryland crops commonly grown in the county are oats and wheat for grazing and for grain. Grain sorghum, cotton, alfalfa, and sudangrass are also grown to some extent. In a suitable cropping system, adapted crops are grown in a sequence that helps to control erosion, supplies organic matter, improves the physical condition of the soil, and helps to control insects and diseases. If perennial grasses or legumes are included in the sequence for 2 years or more, they provide forage and help to maintain tilth and fertility. The grasses most commonly used in the sequence are sorghum almum and blue panic. On the irrigated soils in capability units I-1 and IIe-1, Coastal bermudagrass can be grown for pasture or hay. This use is practical if a good cover is maintained and residue is left on the soils.

Fertilizer.—In this county commercial fertilizer is not commonly used in dryland farming, because rainfall is low and droughts are frequent. On the other hand, larger yields are produced on the Frio, Uvalde, and other irrigated soils if they are fertilized. Most of the soils in the county are low in content of nitrogen and phosphorus, and the Nimrod, Stephenville, and other sandy soils are also low in potassium. The kind and amount of fertilizer needed for a specific crop should be determined by soil tests that are made before the crop is planted. Information that is gained by testing soils, and information on the kinds and amounts of fertilizer to apply, can be obtained from the county agent and representatives of the Soil Conservation Service.

Stripcropping.—In stripcropping, crops are grown in alternate strips so as to protect sandy soils that tend to blow if left bare. The Stephenville and Nimrod soils in capability unit IIIe-5 are of this kind. The strips are planted at right angles to the direction of the prevailing wind. Seeded in one strip are rye, sudangrass, grain sorghum, or similar crops that are close growing or tall. These crops serve as a barrier against the wind and produce a large amount of residue. In alternate strips are planted peanuts, melons, cotton, or other row crops.

Terraces and contour farming.—On the gently sloping soils in capability subclasses IIe, IIIe and IVe, terraces and contour farming are needed primarily to control water erosion and secondarily to conserve moisture. On some of the nearly level soils, terracing and contour farming are used mostly to conserve moisture. Diversion terraces are used in the county to protect the fields from the water flowing from rangeland. For graded terraces, suitable outlets are needed for disposal of the excess water. These outlets need to be established before the graded terraces are built. Rangeland or grassed waterways can be used, without excessive erosion, to carry excess water from the terraces to the natural drainageways.

Managing crop residue.—Crop residue left on the soil after a crop is harvested protects the soil from erosion, reduces evaporation, and improves tilth and fertility. If plowing for the following crop is delayed as long as practical, the soil will be protected longer from erosion and also from loss of moisture through evaporation. Adequate residue left from oats and other grazed crops is also important in protecting the soils. The critical periods of erosion are from March to May and from September to November.

Predicted yields

Table 2 lists, for each soil in the county that is suitable for crops, predicted acre yields of oats and grain sorghum and yields of forage for specified pasture plants. These yields are given for dryfarmed and irrigated soils at a low and a high level of management. Because Coastal bermudagrass is grown only under irrigation, only yields for irrigated soils are given. Several other crops are grown in Menard County but are not shown in table 2, because their acreage is small and data are not reliable.

The predictions are based on information received by interviewing ranchers and farmers and on information obtained from records of the county and the soil conservation district.

The yields to be expected under a low level of management for dryland and irrigated farming are shown in colums A of table 2. The practices used under this level of management for dryfarmed crops, dryfarmed pasture, irrigated crops, and irrigated pasture are as follows:

Dryfarmed crops—

1. Terraces and contour cultivation are poorly planned.
2. Crops are not rotated.
3. Crop residues are grazed off, baled, or plowed under soon after the crop is harvested.
4. Cover crops or soil-improving crops are not used.
5. No pesticide or fertilizer is used.

Dryfarmed pasture—

1. Erosion and runoff are not controlled.
2. No fertilizer is used.
3. Pasture is improperly grazed.
4. Seed is not suited or of poor quality.
5. Poor cultural practices are used.

Irrigated crops—

1. Land leveling or land smoothing is not used.
2. Irrigation is erratic with little regard for crop needs.
3. Crop residues are grazed off, baled, or plowed under soon after the crop is harvested.
4. Cropping system does not include rotations or soil-improving crops.

TABLE 2.—*Predicted average acre yields of*

[Yields in columns A are those obtained under management at a low level; yields in columns B are those obtained

Symbol	Soil [1]	Oats				Grain sorghum			
		Dryland		Irrigated		Dryland		Irrigated	
		A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
BaC	Brackett soils, 2 to 5 percent slopes	10	20	------	------	400	1,000	--------	--------
FcA	Frio clay loam, 0 to 1 percent slopes	25	50	40	65	1,250	2,700	2,000	5,000
FcB	Frio clay loam, 1 to 2 percent slopes	25	50	40	65	1,000	2,500	2,000	5,000
Fs	Frio soils, shallow variants	25	45	------	------	900	2,100	--------	--------
HfC	Hext fine sandy loam, 2 to 5 percent slopes	10	20	------	------	350	1,000	--------	--------
KaB	Kavett silty clay, 0 to 3 percent slopes	15	25	------	------	600	1,500	--------	--------
KnC	Karnes loam, 2 to 5 percent slopes	15	30	------	------	600	1,400	--------	--------
KpA	Knippa silty clay, 0 to 2 percent slopes	20	40	------	------	900	2,000	2,000	4,500
MaB	Menard fine sandy loam, 1 to 3 percent slopes	15	25	------	------	700	1,600	--------	--------
MaC	Menard fine sandy loam, 3 to 5 percent slopes	12	20	------	------	500	1,200	--------	--------
MnA	Menard loam, 0 to 2 percent slopes	25	45	------	------	1,000	1,600	--------	--------
MrA	Mereta clay loam, 0 to 2 percent slopes	15	25	------	------	600	1,500	--------	--------
NdB	Nimrod loamy sand, 0 to 3 percent slopes	12	22	------	------	500	1,200	--------	--------
StB	Stephenville loamy sand, 0 to 3 percent slopes	18	30	------	------	500	1,200	--------	--------
TsA	Tobosa clay, 0 to 1 percent slopes	20	40	------	------	1,000	2,500	--------	--------
TsB	Tobosa clay, 1 to 3 percent slopes	20	40	------	------	800	1,800	--------	--------
UaA	Uvalde silty clay loam, 0 to 1 percent slopes	20	45	30	60	600	1,500	2,000	4,000
UaB	Uvalde silty clay loam, 1 to 3 percent slopes	17	40	------	------	600	1,500	1,700	4,000
VaB	Valera silty clay, 0 to 3 percent slopes	25	50	------	------	800	2,000	--------	--------

[1] Miscellaneous land types, undifferentiated soil groups, soil complexes, and soils not suited to the specified use are not shown.

[2] An animal-unit-month is the number of months that 1 acre will provide grazing for 1 animal, or 1,000 pounds of live weight,

5. Fertilizer and pesticides are used with little planing.

Irrigated pasture—
1. Erosion and runoff are not controlled.
2. Land leveling or land smoothing is not used.
3. Irrigation is erratic.
4. Pasture is improperly grazed.
5. Little or no fertilizer is used.
6. Seed is not suited or is of poor quality.
7. Poor cultural practices are used.

The yields to be expected under a high level of management are shown under columns B of table 2. The practices used under this level of management are as follows:

Dryfarmed crops—
1. Well-planned terraces and a contour system are used.
2. Crop residues are used for maximum soil cover.
3. Soil-improving crops and crops producing a large amount of residue are used in the cropping sequence.
4. Good cultural practices and good seed are used.
5. Pesticides and fertilizer are used when feasible.

Dryfarmed pasture—
1. Erosion and runoff are controlled.
2. Fertilizer is used according to crop needs, when feasible.
3. Rotation grazing and other good grazing management are used.
4. Good-quality seed is used.
5. Good cultural practices are used.

Irrigated crops—
1. A properly designed irrigation system is used.
2. Irrigation water is applied according to crop needs.
3. Crop residues are used for maximum soil cover.
4. Soil-improving crops and crops producing a large amount of residue are used in the cropping sequence.
5. Fertilizer is used according to crop needs.
6. Good cultural practices and insect control are used.

Irrigated pasture—
1. Erosion and runoff are controlled.
2. Land is leveled and smoothed.
3. Irrigation water is applied according to crop needs.
4. Fertilizer is used according to crop needs.
5. Good quality seed is used.
6. Good cultural practices are used.
7. Rotation grazing and other good grazing management are used.

Uses of Soils for Wildlife

Most of the once abundant wildlife in Menard County was killed off after the area was settled. The average rancher considered wildlife worthless until a few years ago when hunting leases became popular. The sale of

major crops under two levels of management

under management at a high level. Absence of data indicates that the crop is not ordinarily grown on the soil]

Pasture									
Small grain				Sudangrass				Coastal bermudagrass	
Dryland		Irrigated		Dryland		Irrigated		Irrigated	
A	B	A	B	A	B	A	B	A	B
Animal-unit-months [2]	*Animal-unit-months* [2]	*Animal-unit-months* [2]	*Animal-unit-months* [2]	*Animal-unit-months* [2]	*Animal-unit-months* [2]	*Animal-unit-months* [2]	*Animal-unit-months* [2]	*Animal-unit-months* [2]	*Animal-unit-months* [2]
1.0	1.8	----------	----------	1.0	2.0	----------	----------	----------	----------
2.5	3.5	3.0	5.0	2.0	3.0	4.0	10.0	10.0	24.0
2.5	3.5	3.0	5.0	2.0	3.0	4.0	10.0	10.0	24.0
2.0	3.0	----------	----------	1.5	3.0	----------	----------	----------	----------
1.0	1.8	----------	----------	1.0	2.0	----------	----------	----------	----------
1.0	2.0	----------	----------	1.0	2.0	----------	----------	----------	----------
1.6	2.5	----------	----------	1.3	2.8	----------	----------	----------	----------
2.5	3.5	3.0	5.0	2.0	3.0	4.0	9.0	10.0	22.0
2.0	3.0	----------	----------	1.5	3.0	----------	----------	----------	----------
1.5	2.5	----------	----------	1.0	2.0	----------	----------	----------	----------
2.0	3.0	----------	----------	1.5	3.0	----------	----------	----------	----------
1.0	2.0	----------	----------	1.0	2.0	----------	----------	----------	----------
1.5	2.5	----------	----------	1.2	2.5	----------	----------		----------
1.5	2.5	----------	----------	1.2	2.5	----------	----------	----------	----------
2.5	3.5	----------	----------	2.0	3.0	----------	----------	----------	----------
2.0	3.5	----------	----------	1.5	3.0	----------	----------		----------
2.5	3.5	3.0	3.5	2.0	3.0	----------	----------	----------	----------
2.5	3.5	3.0	3.5	2.0	3.0	3.0	10.0	10.0	24.0
2.0	3.0	----------	----------	1.5	3.0	3.0	10.0	10.0	24.0

or it is the number of months times the number of animal units. For example, at a high level of management, 1 acre of Knippa silty clay, 0 to 2 percent slopes, in Coastal bermudagrass will graze 11 animals for 2 months and is rated 22 animal-unit-months.

hunting licenses now provides valuable income on many ranches.

The wildlife in the county have a habitat that is chiefly undulating limestone uplands and a few shallow, narrow valleys. The San Saba River flows from west to east and dissects the county. The uplands support a thin stand of live oak trees and many kinds of browse plants. Pecan and other trees and some tall grasses grow in the valleys along the river and large creeks.

Deer are abundant in most parts of the county. Large flocks of turkeys inhabit areas along the river and large creeks. Also plentiful are doves, quail, songbirds, small animals, and predators. The San Saba River, spring-fed sloughs, and stock ponds attract ducks and produce fish.

Described in this subsection are the three wildlife sites in the county and the food and cover needed by the main kinds of wildlife that live in the area.

Wildlife sites

Each of the three wildlife sites in this county covers a large area. The sites are discussed according to their location in the soil associations. The soil associations are described in the section "General Soil Map" and are shown on a map at the back of this report. Each site has different topography, productivity, kinds and amounts of plants, principal species of wildlife, and treatment needs.

WILDLIFE SITE 1

This site is in the uplands. It is made up of the Menard-Hext soil association, the smoother parts of the Tarrant association, and the high part of the Knippa-Uvalde association that is north of the San Saba River, about 50 feet higher than the flood plain. This gently sloping and undulating site is dissected by a few intermittent streams. The herbaceous plants consist of short and mid grasses, legumes and forbs, and live oak, shin oak, and many other kinds of browse plants. The fruit of agarito, Texas persimmon, juniper, and other woody plants provide food for many kinds of wildlife. The principal wildlife on this site are deer, rabbits, doves, quail, turkeys, and songbirds.

WILDLIFE SITE 2

This site consists of bottom lands in the Frio-Uvalde soil association, the parts of the Knippa-Uvalde association that lie along the larger creeks, and the parts that are south of the San Saba River flood plain in the eastern part of the county. This site is nearly level and is cultivated in most areas. On this site are Canada wildrye, switchgrass, Texas bluegrass, and other mid and tall grasses. Bristlegrass, ragweed, vine-mesquite, and Texas wintergrass also grow on this site. A major source of food for wildlife is provided by sunflower, native legumes and hackberry and pecan trees. Large groves of tall, native pecan trees grow beside the streams in most places. The principal wildlife on this site are deer, squir-

rel, beaver, bobcats, raccoons, turkeys, quail, doves, eagles, cranes, and songbirds.

WILDLIFE SITE 3

This site consists of areas of steep hills in the steeper parts of the Tarrant soil association. It occurs on steep breaks between the limestone uplands and the lower lying bottom lands. All of this site is in range. The chief herbaceous plants are sideoats grama, hairy grama, little bluestem, purple three-awn, red grama, and other short and mid grasses. Texas oak and juniper are the chief woody plants. Many kinds of wildlife eat the fruit of Texas persimmon, oak, and juniper. The principal wildlife on this site are deer, raccoons, rabbits, quail, doves, and songbirds.

Food and cover for wildlife

Each species of wildlife requires a certain kind of food, cover, and water supply. If any of these are lacking in an area, the number of wildlife diminishes or the species disappears. The soils in each wildlife site in the county can produce specific plants for food and cover that meet the needs of wildlife. Farmers and ranchers can obtain assistance in developing wildlife habitat from wildlife specialists of the Soil Conservation Service, the Texas Agricultural Extension Service, and the Texas Parks and Wildlife Department.

Deer.—Deer inhabit every ranch in the county that has enough brush and trees to hide them. They are most numerous in the areas where landowners protect and encourage them by improving their habitat. Motts of live oak and thickets of Bigelow oak provide excellent cover and protection for wildlife and are common on Tarrant soils, undulating, in the eastern and northern parts of the county. Single trees and motts of live oak are common in most parts.

Deer prefer to eat legumes, weeds, vines, some grasses, twigs, buds, and the fruits of various shrubs. A major source of food is oak trees and oak shrubs, both of which generally produce a good crop of acorns. The mid and tall grasses and the forbs provide a variety of food on Valera silty clay, Uvalde silty clay loam, and other of the deep or moderately deep soils. Deer also feed heavily on fields of small grain and grain sorghum. Small grain is seeded as a crop on most ranches throughout the county, and it can be seeded on Frio, Uvalde, Knippa, Menard, Kavett, Valera, and other suitable soils so that the habitat for deer is improved.

Wild Turkey.—Wild turkeys inhabit areas near the river and the large creeks. Along these streams the tall trees and wooded areas are essential for roosting and escape cover, and they furnish pecans and acorns for food.

The year-round food of turkeys is the seeds of weeds, grasses, and legumes; the fruits of shrubs; nuts and acorns; and succulent green plants. Turkeys also eat many insects during warm months, and they feed on the grain in cultivated fields.

On Frio, Uvalde, Knippa, and other of the deep soils near streams, good food for turkeys can be provided by planting wheat, grain sorghum, millet, or sorghum almum. The plantings should be close to good cover and preferably near water. In winter the shortage of food for turkeys may be offset by a supplemental feeding of grain.

Quail.—Quail require a year-round supply of food consisting of seeds from weeds, legumes, grasses, small grain, sorghums, and other plants. Many kinds of seed plants grow on the Menard, Valera, Frio, and other soils. Quail also eat many insects and some succulent green herbage. Low-growing shrubs provide shade and cover through which quail escape from predators. The many kinds of plants that grow in fence rows along field borders provide protection and food, as well as a protected trail for the birds as they move from place to place. Plowing encourages the growth of many food-producing weeds and grasses. Good food for quail can be grown on soils suitable for cultivation by planting millet, wheat, grain sorghum, sorghum almum, and similar grain, if these crops are planted at the edge of fields and are not harvested. For best results, the plantings should be near good cover.

Doves.—Some mourning doves nest in Menard County, and others from northern areas either winter or pass through the county. A continuous supply of food is needed for holding doves in an area. Doves eat about the same plant seeds as quail. The major foods for doves are small grain, grain sorghum, and the seed from native grass and weeds. All of these plants grow on the Menard, Valera, and Frio soils. Doves feed heavily on grain in fields that have been harvested. Plantings of millet, wheat, and grain sorghum supply good food for doves. For best results, they should be planted near a waterhole.

Fish.—Catfish, bass, and perch are common in the San Saba River. Some farm ponds are stocked with bass, catfish, and crappie that multiply and grow well if the ponds are properly constructed and managed. Management is needed that provides large amounts of food for fish of different kinds and that controls undesirable aquatic plants that encourages unbalanced populations of fish. Fertilizer added to the water shades out undesirable plants, and increases the growth of microscopic aquatic plants and animals that fish eat. Proper construction of the pond insures permanent water and eliminates shallow areas so that larger fish can feed freely in all the water. Ponds constructed in the Valera, Uvalde, Knippa, and Menard soils may require sealing with bentonite or driller's clay to prevent seepage.

Engineering Uses of Soils [3]

Some soil properties are of special interest to the engineer because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. The properties most important are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell potential, grain size, plasticity, and pH. Depth to the water table, depth to bedrock, and topography of the soil also are important.

The information in this report can be used by engineers to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational uses.

[3] By Robert W. Rothe, agricultural engineer, Soil Conservation Service.

2. Make preliminary estimates of the engineering properties of soils that will help in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, pipelines, airports, and cables and in planning detailed investigations at the selected locations.
4. Locate probable sources of sand, gravel, and other material for use in construction.
5. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
6. Correlate the performance of engineering structures with soil mapping units, and thus develop information for planning that will be useful in designing and maintaining the structures.

With the soil map for identification, the engineering interpertations reported here can be useful for many purposes. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works that involve heavy loads or where excavations are deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Much of the information in this subsection is in tables 3, 4, and 5. Table 3 gives a brief description of the soils in the county and estimates of their physical properties. In table 4 are interpretations of the engineering properties of the soils. Table 5 lists engineering data that were obtained when selected soils in the county were tested.

Some of the terms used by soil scientists may not be familiar to engineers. Other terms, though familiar, may have a special meaning in soil science. Most of the terms used in this section and other special terms are defined in the Glossary at the back of the report.

Engineering classification systems

Two systems of classifying soils are in general use by engineers. Both of these systems are used in this report.

Many engineers use the system of soil classification developed by the American Association of State Highway Officials (AASHO) (*1*). In this system, soils are placed in seven main groups on the basis of field performance. The groups range from A-1 (gravelly soils having high bearing capacity) to A-7 (clayey soils having low strength when wet). Of these groups, only A-2, A-4, A-6, and A-7 occur in Menard County. Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. They are shown in parentheses after the classification symbols in table 5.

The Unified system of soil classification was established by the Corps of Engineers, U.S. Army (*9*). This system is based on the texture and plasticity of soils and the performance of the soils as material for engineering works. Of the 15 classes in this system, 8 are for coarse-grained material, 6 for fine-grained material, and 1 for highly organic material. Each class is identified by a letter symbol. The only classes represented in Menard County are CL, CH, SC, SM, and the borderline class SM-SC. Soils in class CL are silts and clays that have a low liquid limit. CH identifies inorganic clays that are highly plastic. Soils in class SC are sands mixed with an appreciable amount of fines, mostly clay. Class SM consists of sands mixed with an appreciable amount of fines, mostly silt. The class SM-SC is near the borderline between classes SM and SC and consists of soil material that has about the same plasticity.

Engineering properties of the soils

To be able to make the best use of the soil maps and the soil survey report, the engineer needs to know the physical properties of the soil materials and the condition of the soils in place. After the soil materials are tested and the engineer has observed their behavior in engineering structures and foundations, he can develop design recommendations for the units delineated on the soil maps.

In table 3 are brief descriptions of the soils in Menard County and estimates of their properties. Some of the estimates were made on the basis of tests of nine samples from three soil series. The result of those tests are shown in table 5. For those soils not listed in table 5, properties were estimated by comparing the soils not listed with the soils of similar series.

Permeability is estimated for each soil as it occurs in place. The values for permeability given in table 3 were compiled from data in the "Irrigation Guide," that are applicable to the county. The guide is available in local Texas offices of the Soil Conservation Service. The information on permeability contained in this guide was obtained as a result of the cylinder infiltrometer test and from measurements of intake made during actual irrigation.

The available water capacity is given in inches of water per inch of soil and is the amount of water that a soil can hold. It is approximately the amount of water available to plants when the soil is wet to field capacity. This amount of water will wet an air-dry soil to a depth of 1 inch without deeper penetration.

In the column headed "Reaction," the degree of acidity or alkalinity is expressed in pH values. The pH of a neutral soil is 7.0, of an acid soil is less than 7.0, and of an alkaline soil is more than 7.0. Most of the soils in Menard County are alkaline.

The soil percolation rate is used to determine how suitable soils are for disposing effluent from septic tanks. In table 3 this rate is given as the number of minutes required for 1 inch of water to percolate through a saturated soil. If the percolation rate is faster than 1 inch in 45 minutes, the soil is well suited for septic systems; if it is between 45 and 75 minutes, the soil has moderate limitations; if it is slower than 75 minutes, the soil has severe limitations. Estimates can be made from data on soil permeability, even though reliable data on percolation rates are not available. These estimates, however, should be used with caution, for the methods of measuring percolation and permeability differ.

TABLE 3.—*Brief description of soils of Menard County,*

[Dashed lines indicate

Map symbol	Soil name	Description of soil and site	Depth from surface
			Inches
BaC	Brackett soils, 2 to 5 percent slopes.	Gravelly clay loams on uplands; contain disseminated lime; from surface to depth of 10 inches, hard and soft fragments of limestone make up 30 percent of layer, by volume; from 10 to more than 24 inches is gravelly earth containing seams and pockets of lime; 20 to 30 percent of layer is fossil shells and limestone fragments; amount of coarse fragments varies. Texture and other properties too variable for estimate in layer below depth of 10 inches.	0 to 10 10 to 24
Ds	Dev soils.	Gravelly and very gravelly clay loams on bottom lands; limestone pebbles and cobbles make up 0 to 90 percent of upper 20 inches; below 20 inches, 40 to 50 percent of material is limestone pebbles and cobbles; water table between 10 and 20 feet. Depth and other properties too variable to be estimated.	----------
FcA FcB Fr	Frio clay loam, 0 to 1 percent slopes. Frio clay loam, 1 to 2 percent slopes. Frio soils, frequently flooded.	Crumbly, calcareous clay loams on bottom lands; at depth of 36 inches clay loam is underlain by friable, calcareous, silty clay loam that extends to more than 60 inches; waterworn gravel at depth of 4 to 15 feet; water table between 10 and 20 feet in most places.	0 to 36 36 to 60
Fs	Frio soils, shallow variants.	Crumbly, calcareous clay loams on bottom lands along small streams; depth to limestone bedrock ranges from 20 to about 45 inches and averages about 28 inches.	0 to 28
HfC	Hext fine sandy loam, 2 to 5 percent slopes.	Calcareous fine sandy loam that varies in depth and contains few, fine, cemented concretions of calcium carbonate; at depth of 19 inches, fine sandy loam is commonly underlain by loamy calcareous earth that is weakly cemented in upper part and contains knobby concretions of calcium carbonate and angular fragments of limestone. Concretions and fragments make up 20 percent of layer, by volume, below 30 inches; weakly consolidated marl in many places.	0 to 19 19 to 50
KaB	Kavett silty clay, 0 to 3 percent slopes.	Shallow calcareous silty clay loam on uplands; contains angular fragments that range from a few to 5 percent of soil mass; most fragments between 3 and 20 millimeters across; fractured limestone below depth of about 15 inches.	0 to 15
KnC	Karnes loam, 2 to 5 percent slopes.	Crumbly calcareous loam on upland foot slopes; contains a few fine fragments of limestone; at depth of about 32 inches there is calcareous silty clay loam that is less crumbly than layer above and contains few, fine, angular and rounded fragments of limestone; rocks and rock layers below depth of 50 inches in some places.	0 to 32 32 to 50
KpA	Knippa silty clay, 0 to 2 percent slopes.	Calcareous clayey soils on stream terraces; shrinking and swelling indicated by shiny pressure faces of peds; below depth of about 32 inches there is calcareous silty clay containing fine, soft lumps of calcium carbonate that make up about 5 percent of layer, by volume; a few limestone pebbles below a depth of about 5 feet.	0 to 32 32 to 72
MaB MaC	Menard fine sandy loam, 1 to 3 percent slopes. Menard fine sandy loam, 3 to 5 percent slopes.	Noncalcareous, alkaline, moderately coarse textured fine sandy loam; below depth of about 8 inches is noncalcareous, mildly alkaline sandy clay loam, which contains free lime below depth of about 31 inches; below a depth of about 51 inches is calcareous sandy loam containing fine concretions of calcium carbonate and a few waterworn pebbles that together make up 10 percent of the layer, by volume.	0 to 8 8 to 51 51 to 63
MnA	Menard loam, 0 to 2 percent slopes.	Noncalcareous, alkaline, friable loam on uplands; below depth of about 10 inches is noncalcareous, mildly alkaline sandy clay loam containing quartzose pebbles; below about 64 inches is calcareous clay loam containing fewer quartzose pebbles than layer above; few concretions of calcium carbonate.	0 to 10 10 to 31 31 to 64
MrA	Mereta clay loam, 0 to 2 percent slopes.	Calcareous crumbly clay loam on uplands; cemented caliche at depth of 18 to 20 inches; soft caliche and calcareous loamy earth below 20 inches.	0 to 18 18 to 20 20 to 30

Texas, and their estimated properties

no estimate was made]

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Percolation rate
USDA texture	Unified	AASHO	No. 4	No. 10	No. 200					
						Inches per hour	*Inches per inch of soil*	*pH*		*Minutes per inch*
Gravelly clay loam.	CL	A-4	90-100	10-100	50-60	0.8-1.5	0.15	8.0-8.3	Moderate	45-75
Clay loam	CL	A-6 or A-7	90-100	85-98	80-90	0.8-1.5	.18	8.0-8.3	Moderate	45-75
Silty clay loam	CL	A-6 or A-7	95-100	90-98	85-89	0.8-1.5	.15	8.0-8.3	Moderate	
Clay loam	CL	A-6 or A-7	95-99	90-97	85-90	0.8-1.5	.18	7.5-8.3	Moderate	45-75
Fine sandy loam.	SC	A-4	95-100	92-97	35-45	1.5-2.5	.13	8.0-8.3	Low	<45
Loam	CL	A-4	85-90	80-85	55-65	1.5-2.5	.12	8.0-8.3	Moderate	
Silty clay	CL	A-7	80-98	70-95	70-90	1.0	.17	7.0-8.3	Moderate	45-75
Loam	CL	A-4	90-100	85-99	50-70	1.0-2.0	.15	8.0-8.3	Moderate	45-75
Silty clay loam	CL	A-7	90-100	85-95	80-90	1.0-1.8	.17	8.0-8.3	Moderate	
Silty clay	CH	A-7	98-100	97-100	90-95	0.4-1.0	.19	7.5-8.3	High	45-75
Silty clay	CH	A-7	90-100	85-99	80-90	0.4-1.0	.14	8.0-8.3	High	
Fine sandy loam.	SC	A-4	95-100	95-100	35-45	1.5-2.5	.13	6.6-8.0	Low	<45
Sandy clay loam.	SC or CL	A-6 or A-4	97-100	95-100	45-55	0.8-2.0	.17	6.3-7.5		
Sandy loam	SC	A-6	80-90	75-82	40-50	0.8-2.0	.16	8.0-8.3		
Loam	SC or CL	A-4 or A-6	95-100	95-100	45-60	0.8-1.0	.12	6.5-7.5	Low	>60
Sandy clay loam.	SC	A-6	95-100	90-100	35-45	0.7-1.0	.15	6.5-7.5	Moderate	
Clay loam	CH	A-7	85-95	80-90	55-75	0.2-0.8			Moderate	
Clay loam	CL	A-7	95-100	90-100	80-90	1.2-2.0	.19	8.0-8.3	Moderate	45-75
Caliche										
Loam	CL	A-4	95-100	90-98	50-70	1.2-2.0	.19	8.0-8.3		

209-363 66 —3

TABLE 3. *Brief description of soils of Menard County, Texas,*

Map symbol	Soil name	Description of soil and site	Depth from surface
			Inches
NdB	Nimrod loamy sand, 0 to 3 percent slopes.	Noncalcareous loamy sand on uplands; below depth of about 18 inches, and extending to 40 inches, is somewhat compact sandy clay containing a few quartzose pebbles in the lower part; below about 40 inches is sandy loam that is less compact than that in the layer above and that contains few, fine, quartzose pebbles.	0 to 18 18 to 40 40 to 60
Rb	Rough broken land.	Steep areas of limy clay and chalky earth materials that contain fossil shells and gravel; slopes range from about 8 to 50 percent.	----------
StB	Stephenville loamy sand, 0 to 3 percent slopes.	Noncalcareous loamy fine sand on uplands; at depth of about 15 inches is noncalcareous sandy clay loam that, at about 50 inches, is underlain by calcareous sandy clay loam containing a few fine concretions of calcium carbonate.	0 to 15 15 to 50 50 to 60
Ta	Tarrant soils, undulating.	Very shallow calcareous clays and silty clays on uplands; about 20 percent of upper layer, by volume, is angular limestone pebbles, cobbles, and stones, and angular fragments of limestone; below depth of about 6 inches is a 3-inch layer of loose angular fragments of limestone and soil material; layer about 85 percent limestone and 15 percent soil material and is underlain by fractured limestone of varying thickness; slopes range from 0 to 8 percent.	0 to 6
Tb	Tarrant-Brackett association, hilly.	For description and properties of Tarrant soils, see Tarrant soils, undulating; for description and properties of Brackett soils, see Brackett soils, 2 to 5 percent slopes.	----------
Tk	Tarrant-Kavett complex, nearly level.	For description and properties of Tarrant soils see Tarrant soils, undulating; for description and properties of Kavett soils, see Kavett silty clay, 0 to 3 percent slopes.	----------
Tr	Terrace escarpments.	Mixed alluvial gravel, sand, silt, and clay, of which about 50 percent is gravel; few large pieces of limestone and conglomerate on slopes; slopes range from about 2 to 20 percent.	----------
TsA TsB	Tobosa clay, 0 to 1 percent slopes. Tobosa clay, 1 to 3 percent slopes.	Calcareous clay on uplands; contains a few fine fragments of limestone; at depth of about 30 inches is clay containing slightly more calcium carbonate than layer above; limestone at depth of about 45 inches.	0 to 30 30 to 45 45+
UaA UaB	Uvalde silty clay loam, 0 to 1 percent slopes. Uvalde silty clay loam, 1 to 3 percent slopes.	Crumbly silty clay loam on uplands; rich in lime; contains few pebbles and a few soft lumps of calcium carbonate; at about 32 inches, material is similar to that in layer above but contains slightly more calcium carbonate and slightly less clay.	0 to 32 32 to 64
VaB	Valera silty clay, 0 to 3 percent slopes.	Calcareous silty clay on uplands; silty clay extends to depth of 19 inches and is crumbly in upper part but firmer as depth increases; concretions of calcium in lower part; at 19 inches is a layer of calcareous, crumbly silty clay loam of which about 10 percent is concretions of calcium carbonate and fragments of limestone; between depths of 27 and 54 inches are limestone cobbles and flags and fractured hard limestone, cemented in upper few inches by caliche.	0 to 24 24 to 33

and their estimated properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential	Percolation rate
USDA texture	Unified	AASHO	No. 4	No. 10	No. 200					
						Inches per hour	*Inches per inch of soil*	*pH*		*Minutes per inch*
Loamy sand	SM	A-2	95-100	85-100	3-13	2.5-5.0	0.06	6.0-7.0	Low	>75
Sandy clay	SC	A-7 or A-6	95-98	80-95	35-50	0.1-0.8	.15	5.0-6.0	Moderate	
Sandy clay loam.	SC	A-6	95-100	80-97	35-45	0.1-0.8	.13	5.0-6.0	Moderate	
---	---	---	---	---	---	---	---	---	---	
Loamy sand	SM-SC	A-2	100	96-100	12-18	2.5-5.0	.10	5.5-6.0	Low	30-75
Sandy clay loam.	CL	A-6	95-98	90-98	50-75	1.0	.17	5.5-6.5	Moderate	
Sandy clay loam.	CL	A-6	85-100	75-98	50-60	1.0	.17	6.0-8.3	Moderate	
Cobbly clay	CH or SC	A-7	70-90	65-85	35-80	0.75	.18	7.0-8.3	Moderate	<45
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Clay	CH	A-7	99	95-98	75-95	0.05-0.2	.21	8.0-8.3	High	>75
Clay	CH	A-7	99	98	75-90	0.05-0.2	.21	8.0-8.3	High	
Limestone	---	---	---	---	---	---	---	---	---	
Silty clay loam.	CL	A-7	98-100	95-100	80-89	0.5-1.5	.19	8.0-8.3	Moderate	45-75
Silty clay loam.	CL	A-6	95-97	90-95	80-88	0.5-1.5	.19	8.0-8.3	Moderate	
Silty clay	CH	A-7	95-98	90-95	85-92	0.5-1.5	.21	8.0-8.3	High	45-75
Silty clay loam.	CL	A-6	95-98	90-95	50-90	0.4-1.0	.19	8.0-8.3	Moderate	

TABLE 4.—*Engineering interpretation for soils in Menard County*

Soil series and map symbol	Suitability as source of—		Soil features adversely affecting—					
	Topsoil	Road fill	Highway location	Farm ponds: Reservoir area	Farm ponds: Embankment	Sprinkler irrigation	Field and diversion terraces	Waterways
Brackett (BaC)	Poor	Poor	Moderate slopes; fair traffic-supporting capacity.	Marly earth substratum; may require sealing.	Fair strength and stability; coarse fragments.	Shallowness; leveling limited on steeper slopes; low productivity.	High erodibility.	Excessive lime; high erodibility.
Dev (Ds)	Poor to fair; gravelly.	Poor to fair.	Frequent flooding.	Very gravelly material; frequent flooding.	Gravelly to stony material.	Not applicable.	Not applicable.	Not applicable.
Frio (FcA, FcB)	Good	Poor	Fair traffic-supporting capacity; occasional or frequent flooding.	Moderate permeability; occasional flooding.	Fair stability; fair compactability.	No unfavorable features.	Occasional flooding.	Occasional flooding.
Frio (Fr)	Good	Poor	Frequent flooding.	Frequent flooding.	Frequent flooding.	Frequent flooding.	Frequent flooding.	Frequent flooding.
Frio (Fs)	Good in surface layer.	Poor	Occasional flooding; fair traffic-supporting capacity.	Limestone about 2 to 4 feet below surface.	Fair stability; fair compactability.	No unfavorable features.	Occasional flooding.	Occasional flooding.
Hext (HfC)	Fair in surface layer.	Fair	Easily eroded slopes.	Rapid permeability.	Low strength and stability; inferior binder material.	Rapid permeability; low water-holding capacity; low fertility.	High erodibility.	High erodibility; low productivity.
Kavett (KaB)	Good	Poor	Easily eroded slopes; less than 20 inches to limestone.	Shallowness to fractured limestone.	Shallowness; fair stability; fair compactability.	Shallowness; slow intake of water.	Shallowness.	Not applicable.
Karnes (KnC)	Good in surface layer.	Poor to fair.	Easily eroded slopes.	Rapid permeability.	Low strength and stability.	Rapid permeability; fair water-holding capacity; excessive lime.	High erodibility.	High erodibility; excessive lime.
Knippa (KpA)	Good in surface layer.	Poor to fair.	Very poor traffic-supporting capacity; high shrink-swell potential.	Substratum may require sealing.	Highly plastic soil material.	Uneven surface; leveling required.	No unfavorable features.	No unfavorable features.
Menard (MaB, MaC, MnA).	Good in surface layer.	Poor to fair.	No unfavorable features.	Sandstone or limestone at depth of 6 to 8 feet.	Fair strength and stability; inferior binder material.	No unfavorable features.	No unfavorable features.	High erodibility; low productivity.
Mereta (MrA)	Good in surface layer.	Poor to fair.	Easily eroded slopes.	Rapid permeability; substratum may require sealing.	Very rapid permeability.	Uneven surface; leveling required; shallowness prevents deep leveling.	Shallowness.	Shallowness.

TABLE 4.—*Engineering interpretation for soils in Menard County*—Continued

Soil series and map symbol	Suitability as source of—		Soil features adversely affecting—					
	Topsoil	Road fill	Highway location	Farm ponds: Reservoir area	Farm ponds: Embankment	Sprinkler irrigation	Field and diversion terraces	Waterways
Nimrod (NdB)	Fair	Good	Easily eroded slopes; fair traffic-supporting capacity.	Rapid permeability in surface soil; subsoil has good compactability.	Fair stability; fair to good compactability.	No unfavorable features.	Poor stability.	Poor stability; low productivity.
Rough broken land (Rb).	Not suitable.	Poor to fair.	Easily eroded slopes.	Stoniness	Stoniness	Not applicable.	Not applicable.	Not applicable.
Stephenville (StB).	Good in surface layer.	Fair	Easily eroded slopes; plastic subsoil.	Rapid permeability in surface soil.	Plastic subsoil.	Slow permeability in subsoil; low fertility.	Easily eroded surface soil.	Easily eroded surface soil; low fertility.
Tarrant (Ta, Tb, Tk). (For properties of the Brackett soil in mapping unit Tb, and those of Kavett soil in unit Tk, refer to interpretations in this table for Brackett and Kavett soil series, respectively.)	Poor	Poor to fair.	Very shallow soil.	Clay is very shallow over fractured limestone.	Clay is very shallow; coarse fragments.	Not applicable.	Not applicable.	Not applicable.
Terrace escarpments (Tr).	Poor	Poor to fair; variable.	Unstable slopes.	Moderate permeability; variable amount of gravel that is about 50 percent of soil material in some places.	Steep slopes; coarse fragments.	Not applicable.	Not applicable.	Not applicable.
Tobosa (TsA, TsB).	Poor	Poor	Very poor traffic-supporting capacity; high shrink-swell potential.	Shallowness; limestone at a depth of 2 to 4 feet.	High shrink-swell potential.	Slow intake of water.	No unfavorable features.	No unfavorable features.
Uvalde (UaA, UaB).	Good in surface layer.	Poor to fair.	Plastic soil material; easily eroded slopes.	Sealing of substratum may be required.	Plastic soil material.	Uneven surface.	No unfavorable features.	No unfavorable features.
Valera (VaB)	Good in surface layer.	Poor	Poor traffic-supporting capacity.	Shallowness; limestone at a depth of 2 to 4 feet.	Fair stability; fair compactability.	No unfavorable features.	No unfavorable features.	No unfavorable features.

TABLE 5.—*Engineering test data for soil samples*

[Tests performed by the Texas Highway Department in accordance with standard procedures

Soil name and location	Parent material	Texas report No.	Depth	Horizon	Shrinkage		
					Limit	Lineal	Ratio
			Inches			*Percent*	
Knippa silty clay:							
4.4 miles east of Fort McKavett on Ranch Road 864. (Modal profile)	Alluvium.	62–377–R	5–15	A12	12	18. 0	1. 94
		62–378–R	15–32	AC	12	18. 2	1. 95
		62–379–R	32–60	Cca	13	14. 4	1. 92
2.7 miles east of Fort McKavett on Ranch Road 864. (Heavy)	Alluvium.	62–380–R	5–36	A12	10	21. 0	1. 99
		62–381–R	36–49	AC	11	19. 5	1. 99
		62–382–R	49–69	Cca	12	16. 3	1. 94
0.5 mile south of Rocky Creek and 19 miles northwest of Menard. (Strongly developed Cca horizon)	Alluvium.	62–388–R	5–20	A12	12	19. 0	1. 94
		62–389–R	20–30	AC	10	21. 0	2. 00
		62–390–R	36–56	Cca	15	13. 5	1. 83
Menard fine sandy loam:							
0.5 mile south southwest of Hext. (Modal profile)	Calcareous earth.	62–383–R	14–31	B22	13	10. 6	1. 90
		62–384–R	51–63	C	17	6. 0	1. 83
3.4 miles northeast of London, in Kimble County. (Heavy)	Calcareous earth.	62–399–R	10–22	B22	12	15. 6	1. 96
		62–400–R	32–62	C	12	11. 0	1. 94
0.9 mile east of Hext on State Route 29. (Light)	Conglomerate sandstone.	62–397–R	18–31	B22	16	16. 0	1. 81
		62–398–R	31–52	C	13	7. 4	1. 91
Uvalde silty clay loam:							
0.5 mile south and 5.5 miles east of Menard on Farm Road 2092. (Modal profile)	Alluvium.	62–385–R	4–13	A12	15	15. 3	1. 90
		62–386–R	13–25	A13	14	16. 4	1. 92
		62–387–R	29–50+	C	14	12. 1	1. 90
5.0 miles east of Menard on Farm Road 2092. (Heavy)	Alluvium.	62–391–R	6–14	A12	14	15. 6	1. 88
		62–392–R	14–37	AC	13	17. 0	1. 89
		62–393–R	37–48	Cca	18	10. 0	1. 78
9.8 miles east of Menard on State Highway No. 29. (Light)	Alluvium.	62–394–R	6–13	A12	13	12. 5	1. 90
		62–395–R	13–20	AC	14	12. 1	1. 88
		62–396–R	20–44	Cca	12	12. 1	1. 97

[1] Mechanical analyses according to the AASHO Designation T: 88–57. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-sized fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is ana-

The shrink-swell potential indicates a change in volume that occurs in a soil. Ordinarily, shrink-swell potential is rated *low*, *moderate*, *high*, or *very high*. In table 3, however, the very high rating is not assigned to any soil, because sufficient laboratory or field tests have not been made. The other ratings are based on the shrink-swell potential of all the soils in the United States, not only the potential of those soils in Menard County. In general, soil materials classed CH and A-7 have a high shrink-swell potential. Soil materials having a low shrink-swell potential are clean, structureless (single grain) sands and gravel, materials having small amounts of nonplastic and slightly plastic fines, and most other nonplastic and slightly plastic materials.

Engineering interpretations

In table 4 the soils are rated according to their suitability as sources of topsoil and of road fill. Also listed for the soils are properties that affect the suitability of the soils as sites for specified engineering uses. The data in table 4 were estimated on the basis of the test data in table 5, the properties listed in table 3, and observations of the field performance of the soils.

Topsoil is fertile soil material that ordinarily is rich in organic matter. It is used to topdress roadbanks, gardens, and lawns. Areas of Frio soils that are loamy and fertile are good sources of topsoil. On the other hand, Brackett soils have a very high content of lime and are poor sources. The Nimrod soils normally are too sandy for use as topsoil, but they can be used successfully if water and fertilizer are added.

The suitability of a soil for road fill depends largely on the texture and plasticity of the soil and the natural content of water. Plastic soils, such as Tobosa clay, are difficult to compact and are rated *poor* as a source of road-fill material. Nimrod loamy fine sand is rated

taken from selected soil profiles

of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [1]									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—					AASHO [2]	Unified [3]
1½-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0. 05 mm.	0. 005 mm.	0. 002 mm.				
			100	95	92	87	52	41	53	31	A-7-6(19)	CH.
			100	93	90	85	55	45	54	31	A-7-6(19)	CH.
		100	99	91	88	84	55	39	44	26	A-7-6(15)	CL.
			100	97	96	92	64	52	62	40	A-7-6(20)	CH.
			100	99	98	95	65	53	57	37	A-7-6(19)	CH.
			100	98	96	93	60	46	49	31	A-7-6(18)	CL.
	100	99	99	96	95	91	57	46	57	33	A-7-6(19)	CH.
		100	99	98	97	95	63	53	61	40	A-7-6(20)	CH.
	100	97	95	90	86	85	60	45	44	26	A-7-6(15)	CL.
			100	94	56	48	29	27	34	20	A-6(8)	CL.
100	99	89	82	71	50	46	28	20	28	12	A-6(4)	SC.
		100	98	82	52	49	36	33	46	30	A-7-6(11)	CL.
	100	92	85	73	54	52	27	20	34	20	A-6(8)	CL.
	100	96	80	40	26	25	21	18	54	30	A-2-7(2)	SC.
100	87	68	61	56	36	31	14	10	26	14	A-6(1)	GC.
			100	92	89	84	47	38	49	28	A-7-6(17)	CL.
			100	97	95	90	56	46	51	31	A-7-6(18)	CH.
	100	97	95	92	88	85	53	39	39	22	A-6(13)	CL.
			100	98	94	88	48	39	50	28	A-7-6(17)	CL.
			100	99	96	92	60	49	52	31	A-7-6(18)	CH.
100	99	93	91	88	83	78	56	40	39	21	A-6(12)	CL.
	100	99	98	96	83	75	42	33	39	22	A-6(13)	CL.
	100	99	98	89	80	73	45	34	39	23	A-6(13)	CL.
	100	94	91	87	79	72	45	32	36	21	A-6(12)	CL.

lyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

[2] Based on AASHO Designation M: 145-49 (*1*).

[3] Based on the Unified Soil Classification System (*9*).

good as a source of road fill; its subsoil and surface soil mixed together contain enough fines for compaction. Rough broken land is a possible source of hard caliche and gravelly earth material that can be used as road fill. Dev soils and Terrace escarpments are good sources of gravel.

The soil features listed in table 4 as those adversely affecting highway location were selected on the basis of the estimated soil classification. In flat areas the features listed apply to the soil materials in the A and B horizons, or to the materials between the surface and a depth of about 3 feet. In rolling areas where slopes are about 5 percent or more, the features listed apply primarily to the soil materials in the C horizon, or to materials below a depth of about 3 feet. Soils that have a plastic clay layer, such as Tobosa clay and Knippa silty clay, have a high shrink-swell potential and are poor for highway locations. Unless they are confined, Nimrod loamy sand and other coarse-textured soils have only a fair capacity for supporting traffic. Also, these soils erode readily.

Frio clay loam and other soils that are frequently flooded do not make good reservoir areas. Brackett soils are unsuitable as reservoir areas, because the marly earth material in their substratum permits water to seep. In addition, Brackett soils contain coarse fragments of rock that affect the capacity of the soils to hold water. Reservoir areas and embankments for farm ponds are also impaired by frequent flooding, stoniness, bedrock near the surface, and highly permeable soil material.

In Menard County sprinkler irrigation is used on about 2,200 acres of Frio, Uvalde, and Knippa soils. Other soils in the county are suitable for irrigation if water is available. In table 4 the soil features that

affect sprinkler irrigation are given. For example, the frequent flooding on Frio soils, frequently flooded, makes sprinkler irrigation risky. Also, on Hext fine sandy loam and other soils, sprinkler irrigation is affected by low water-holding capacity and low productivity.

Field terraces that are constructed on coarse-textured soils are difficult to maintain because the soils are unstable. One such soil is Nimrod loamy sand. Also, diversion terraces built on Frio clay loam, frequently flooded, may be damaged or destroyed by floodwater.

Grassed waterways are developed on soils to carry off the excess of water that is discharged from terraces, diversions, and other areas. An excess of lime adversely affects the construction of waterways, makes the soil droughty, and retards the establishment of vegetation. The Brackett and the Karnes soils contain excessive lime. Frequent flooding also is hazardous to the waterways, for the floodwaters may retard growth or kill the plants in the waterways. The low productivity of the Nimrod, Hext, and other soils that have a loamy sand or fine sandy loam surface layer can be offset by adding fertilizer.

Engineering test data

The engineering test data for three soil series are given in table 5. Samples were taken, by horizons, from nine soil profiles and were tested by the Texas Highway Department according to standard procedures of the American Association of State Highway Officials (*1*). Three profiles of each soil were sampled. The first is a modal profile, or a profile most typical of that soil as it occurs in Menard County. The second and third are nonmodal profiles, or profiles that vary from the modal but are in the range allowed for that series.

Some of the terms used in table 5 may require explanation. As moisture is removed from a soil, the volume of the soil decreases, in direct proportion to the loss of moisture, until a condition of equilibrium, called the *shrinkage limit*, is reached. Beyond the shrinkage limit, more moisture may be removed, but the volume of soil does not change. In general, the lower the shrinkage limit, the higher the content of clay.

Lineal shrinkage is the decrease in one dimension of the soil mass that occurs when the moisture content is reduced from a stipulated percentage to the content at shrinkage limit. Lineal shrinkage is expressed as a percentage of the original dimension.

The *shrinkage ratio* is the volume change resulting from the drying of soil material, divided by the loss of moisture caused by drying. The ratio is expressed numerically.

The engineering soil classifications in table 5 are based on data obtained by mechanical analyses and by tests to determine the liquid limit and the plastic limit. The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the material passes to a liquid state. The *plasticity index* is the numerical difference between the plastic limit and the liquid limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Genesis, Classification, and Morphology of Soils

The purpose of this section is to present the outstanding morphologic characteristics of the soils of Menard County and to relate them to the factors of soil formation. The section consists of three main parts. The first part tells how the soils of Menard County were formed. In the second part the soil series are placed in higher categories of the two systems of soil classification currently used. In the third part the morphology of the soils is discussed, and the profile of a soil representative of each soil series is described.

Factors of Soil Formation

Soil is produced when soil-forming processes act on materials deposited or accumulated by geologic agencies (*2*). The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent materials; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material.

Climate and living organisms, chiefly vegetation, are the active factors of soil formation. They act on parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil. It may be much or little, but some time is always required for horizon differentiation. Usually, a long time is required for the development of distinct soil horizons.

The five factors of soil genesis are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor, unless conditions are specified for the other four. Many of the processes of soil formation are unknown.

Parent material

The kind of parent material determines the kind of minerals with which other soil-forming processes form a soil. If the parent materials contain much clay, the resulting soils also contain much clay. Generally, the sandy materials give rise to sandy soils. The calcareous, clayey uplands provide materials for calcareous, fine-textured alluvial soils.

The soils of Menard County have developed from three kinds of parent materials. Most of the soils on the uplands were derived from limestone. Some soils of the shallow valleys have developed from valley fill or old alluvium from the limestone uplands and contain much clay and silt. Soils in the Hext and Saline communities have developed from loamy earth, sandstone, or conglomerate. The alluvial soils along streams have developed in materials recently transported from surrounding soils and are similar to those soils. The Nimrod and Stephen-

ville soils developed from sandy clays containing little lime and are the only soils in Menard County that do not have free lime in the solum. Most of the parent materials of soils in the county contain a large amount of exchangeable bases.

Climate

Rainfall, temperature, humidity, and wind have been important in the development of soils in Menard County. The climate is subhumid, warm temperate, and continental.

Because much of the rain falls as short, heavy showers, much of the total preciptation is lost as runoff. Water seldom penetrates the deep soils below the root zone, and lime and other minerals have not been leached out of the soils. Lime has accumulated in the subsoil of most soils because moisture generally does not penetrate below the subsoil. The Karnes, Frio, and other immature soils have free lime throughout their profile, but they lack large accumulations in their subsoil because the lime has not been leached. In the Nimrod and other sandy soils that absorb all the rainwater, the moisture frequently penetrates through the whole profile and passes out through underlying layers. In these soils the lime has been leached out and the profile is acid throughout.

Low humidity and the resulting evaporation have also made rainfall less effective in soil development. High summer temperatures have lowered the fertility of all the soils by retarding the accumulation of organic matter.

Relief

Relief, or inequalities of the land surface, has influenced soil development through its effect on runoff, erosion, and drainage. The degree of profile development depends on the amount and penetration of moisture, if other factors of soil formation are about equal. If there is too much runoff, as occurs on steep slopes, little water enters the soil and soil formation proceeds slowly. The development of soils on steep slopes is often exceeded by erosion, and soils have little chance to develop deep profiles. In nearly level or gently sloping areas that receive runoff from higher slopes, the soil material accumulates, moisture penetrates deeply, and deep soils do form. Where there is little or no runoff and the moisture penetrates deeply, clay minerals may be washed into the subsoil. This movement of clay leaves the surface soil sandy and makes the subsoil clayey.

In many places relief affects the kinds and amounts of plants that grow on a soil. The steep slopes of Tarrant-Brackett association, hilly, are an extreme example of relief affecting vegetation. The south-facing slopes of this mapping unit are exposed to the direct rays of the sun, and as a result, vegetation is sparse. The north-facing slopes receive less sunlight and are heavily covered with trees, shrubs, and grasses. Soils on south-facing slopes are eroded, are light colored, and contain a small amount of organic matter. Conversely, soils on north-facing slopes are dark and contain much organic matter.

Living organisms

Plants, micro-organisms, worms, and other forms of life, including men, have contributed to soil development.

Plants have played a major role in soil development in Menard County. The mid grasses on the limestone prairies have added much organic matter to the soils. Roots of grasses and trees have decayed and have left, through the soils, pores and holes that serve as passageways for water. Tree roots have loosened the stones and gravel beneath the soil and have increased the depth that grass roots penetrate. The post oak and blackjack oak that grew on the sandy soils added acid organic matter that hastened leaching and increased acidity.

Many of the soils have been well worked by earthworms. Worms hasten the decay of organic matter, and worm casts improve the movement of water and the growth of roots. Fungi, bacteria, actinomyces, and other micro-organisms help in decaying the organic matter and in improving fertility.

Tillage and use of the soils by man have affected soil development. Man has sped up soil erosion by permitting overgrazing and by using cropland poorly. By using poor cropping systems, he has depleted the soil of fertility and destroyed tilth. Many cultivated fields have lost most of their original organic matter. By poor cultural practices, man has compacted the soils and slowed their intake of water. On irrigated land, he has increased the amount of water that normally flows through the soil. The misuse of native grassland has changed the kinds and amounts of plants, and these plants in time will further affect the character of the soils.

Time

Soil formation requires time. Several thousand years may be required for a soil to become mature, or to have well-defined horizons. The time required for a soil to develop depends on the other factors of soil formation. If the other factors are about equal, soils that have been in place for only a short time show little horizon development; conversely, those that have been in place for a long time have well-defined horizons.

Karnes loam is an example of an immature soil. Its parent materials have been washed from the higher soils in recent times; its horizons are not well defined; and not much lime has been leached from its surface layer. Menard fine sandy loam is a more mature soil and has well-defined horizons. Clay and iron have been leached from its surface layer and deposited in the subsoil. Also, lime has been deposited in the upper part of the parent material.

Classification of the Soils

Soils are classified so that we may more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First, through classification and then through use of soil maps, we can apply our knowledge of soils to specific tracts and other parcels of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in

209-363—66——4

TABLE 6.—*Classification of soil series*

Series	New classification [1]					1938 system and later revisions
	Family	Subgroup	Great group	Suborder	Order	Great soil group
Brackett	Fine loamy, carbonatic, thermic, thin.	Rendollic Ustochrepts.	Ustochrepts	Ochrepts	Inceptisols	Lithosols.
Dev	Loamy skeletal, carbonatic, thermic.	Cumulic Haplustolls.	Haplustolls	Ustolls	Mollisols	Alluvial soils.
Frio	Fine, mixed, thermic	Cumulic Haplustolls.	Haplustolls	Ustolls	Mollisols	Alluvial soils.
Hext	Coarse loamy, mixed, thermic thin.	Rendollic Ustochrepts.	Ustochrepts	Ochrepts	Inceptisols	Regosols.
Karnes	Fine loamy, carbonatic, thermic.	Rendollic Eutrochrepts.	Ustochrepts	Ochrepts	Inceptisols	Regosols.
Kavett	Fine, montmorillonitic, thermic.	Lithic Calciustolls	Calciustolls	Ustolls	Mollisols	Reddish Chestnut soils intergrading to Lithosols.
Knippa	Fine, montmorillonitic, thermic.	(2)	Calciustolls	Ustolls	Mollisols	Grumusols.
Menard	Fine loamy, mixed, thermic	Mollic Haplustalfs	Haplustalfs	Ustalfs	Alfisols	Reddish Prairie soils.
Mereta	Fine loamy, mixed, thermic	Typic Calciustolls	Calciustolls	Ustolls	Mollisols	Calcisols.
Nimrod	Fine, mixed, thermic	(2)	Haplustalfs	Ustalfs	Alfisols	Red-Yellow Podzolic soils.
Stephenville.	Fine loamy, siliceous, thermic.	(2)	Haplustalfs	Ustalfs	Alfisols	Red-Yellow Podzolic soils.
Tarrant	Fine, montmorillonitic, thermic.	Lithic Haplustolls	Haplustolls	Ustolls	Mollisols	Lithosols.
Tobosa	Thermic	Typic Chromusterts.	Chromusterts	Usterts	Vertisols	Grumusols.
Uvalde	Fine mixed, thermic	Haplic Calciustolls	Calciustolls	Ustolls	Mollisols	Calcisols.
Valera	Fine, montmorillonitic, thermic.	Petrocalcic Calciustolls.	Calciustolls	Ustolls	Mollisols	Grumusols.

[1] Placement of some soil series in the present system of classification, particularly families, may change as more information becomes available.

[2] Classification has not been made for subgroup.

managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Likewise, soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of natural classification of soils are now in general use in the United States. One of these is the 1938 system (*8*), with later revisions (*7*). The other, a new system, was placed in general use by the Soil Conservation Service in 1965. The reader who is interested in the new system should search for the latest literature (*4*, *6*). In this report classes in the newer system and great soil groups of the older system, are given (see table 6). The classes in the new system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized in the new system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions are the Entisols and Histosols, which occur in many different climates.

Table 6 shows the four soil orders in Menard County—Vertisols, Inceptisols, Mollisols, and Alfisols. Vertisols are soils in which natural churning or inversion of soil material takes place, mainly through the swelling and shrinking of clay. Soils of this order were formerly called Grumusols. Inceptisols most often occur on young, but not recent, land surfaces; hence, their name is derived from the Latin *inceptum*, for beginning. The soils of this order in Menard County formerly were called Regosols and Lithosols. Mollisols have a dark surface layer that is friable or soft; hence, their name is derived from the Latin *mollis*, meaning soft. The soils of this order in Menard County formerly were classified in the Reddish Chestnut, Alluvial, Lithosol, Grumusol and Calcisol great soil groups. Alfisols are soils containing clay-enriched B horizons that have high base saturation. The soils of this order in Menard County were formerly classified in the Reddish Prairie and Red-Yellow Podzolic great soil groups.

SUBORDER: Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUPS: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly cal-

cium, magnesium, sodium, and potassium), and the like. The name of the great group is the last word of the name of the subgroup.

SUBGROUPS: Great groups are subdivided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Chromusterts (a typical Chromustert).

FAMILIES: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils where used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES: The series is a group of soils having major horizons that, except for texture of surface layer, are similar in important characteristics and in arrangement in the profile. The soil series generally is given the name of the geographic location near the place where a soil of that series was first observed and mapped. An example is the Hext series.

Morphology of the Soils

In this subsection the outstanding morphologic characteristics of each soil series in Menard County are given. The general location of each series in the county is given. Then, a soil profile typical of the series is described in detail, and the range of important characteristics is given. Rough broken land and Terrace escarpments are miscellaneous land types and not members of a soil series; therefore, they are not discussed in this subsection.

BRACKETT SERIES

The Brackett series consists of loamy, calcareous, and thin soils over chalky marl or soft limestone in the Edwards Plateau physiographic area of Menard County. These soils are not extensive in the county; they occur in narrow bands on steep slopes and along narrow ridges below these slopes.

The Brackett soils are lighter colored than the Tarrant soils, which are over hard limestone. They are not so brown nor so loamy as the Hext soils. Brackett soils are not so deep as the Karnes soils, which occur in similar positions but at lower elevations.

Typical profile of Brackett gravelly clay loam in native range (6.0 miles east of Menard and about 800 feet north of Farm Road 2092):

A1—0 to 10 inches, light brownish-gray (10YR 6/2) gravelly clay loam, dark grayish brown (10YR 4/2) when moist; moderate, very fine, subangular blocky and fine, granular structure; hard when dry, friable when moist; 75 percent of surface covered with rounded and subangular fragments of soft limestone ranging from 1/4 inch to 4 inches across; 30 percent of soil mass is fragments of hard and soft limestone; very strongly calcareous; clear boundary.

C—10 to 24 inches +, pale-yellow (2.5Y 7/3) gravelly limy earth, light olive brown (2.5Y 5/3) when moist; many fine pockets and seams of calcium carbonate; 20 to 30 percent of the soil mass is fossil shells and limestone fragments.

The solum ranges from clay loam to loam, and the substratum ranges from clay to clay loam. The solum is 4 to 18 inches thick and is thickest on gentle slopes. The surface layer ranges from light gray to dark grayish brown. Limestone fragments are few to abundant on the surface and throughout the solum. Shell fossils commonly occur on steep slopes.

DEV SERIES

The soils of the Dev series have a gravelly, loamy, calcareous A horizon over a lighter colored, very gravelly and stony, calcareous, loamy C horizon or limestone bedrock. They occur along the flood plains of streams throughout the county.

The Dev soils are more gravelly and stony than the Frio soils and are not so deep. They occur closely with Valera soils, which are not gravelly and are higher than the flood plains of streams.

Typical profile of Dev very gravelly clay loam in native pasture (4.6 miles southwest of Menard on Ranch Road 2291):

A11—0 to 8 inches, dark grayish-brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky and granular structure; hard when dry, friable when moist; 50 percent, by volume, is fine limestone pebbles and fragments, and a few cobblestones and stones; calcareous; diffuse boundary.

A12—8 to 21 inches, clay loam same color as layer above; moderate, fine, subangular blocky structure; hard when dry, firm but crumbly when moist; 50 percent, by volume, is coarse fragments of limestone, including pebbles, cobbles, and stones as much as 15 inches across; calcareous; diffuse boundary.

C—21 to 52 inches, grayish-brown (10YR 5/2) very gravelly clay loam, dark grayish brown (10YR 4/2) when moist; 75 to 85 percent, by volume, is fine pebbles, cobbles, stones, and limestone fragments; stones range from 10 to 24 inches across and are few to common; calcareous; abrupt boundary.

R—52 inches +, limestone bedrock that forms the floor of nearby stream channels.

Where dry, the A horizons range from very dark grayish brown to brown in the hue of 10YR. The fine material ranges from clay loam to silty clay loam. The volume of coarse fragments ranges from 50 to 90 percent of the soil mass in the A horizons and from 50 to 95 percent in the C horizon. Depth to the substratum ranges from 20 to 60 inches. Below the C horizon the substratum ranges from hard limestone to soft lime.

FRIO SERIES

The Frio series consists of deep, dark grayish-brown, crumbly, calcareous alluvial soils. They occur on the flood plains of streams that drain the semiarid and subhumid limestone uplands. Frio soils are not extensive in Menard County; they occur on the flood plains of the San Saba River and the large creeks. These soils are nearly level to gently sloping and are occasionally to frequently flooded. Their surface ranges from nearly flat to uneven or choppy.

The Frio soils are at lower elevations than the Uvalde soils and are nearer the streams. They are less clayey and more crumbly than the higher lying Knippa soils.

They are deeper, more productive, and contain fewer pebbles, cobbles, and stones than the Dev soils.

Typical profile of irrigated Frio clay loam (0.5 mile east of Menard city limits and about 100 feet south of a paved road):

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; hard when dry, firm when moist; calcareous; abrupt boundary.

A11—5 to 14 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate to strong, very fine, blocky and subangular blocky structure; very hard when dry, firm but crumbly when moist; calcareous; gradual boundary.

A12—14 to 36 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; structure and consistence same as in layer above; calcareous; gradual boundary.

C—36 to 60 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; slightly hard when dry, friable when moist; calcareous; many fine threads of calcium carbonate.

The profile ranges from clay loam to silty clay. When dry, the Ap, A11, and A12 horizons range from dark grayish brown to very dark grayish brown in a hue of 7.5YR or 10YR. The A13 horizon, if present, ranges from dark brown to grayish brown. In places an AC horizon occurs and ranges from brown to light yellowish brown. The thickness of the A horizons combined ranges from about 30 to 42 inches. Depth to beds of waterworn gravel ranges from 4 to 15 feet. In places areas of Frio soils along the creeks are underlain by limestone at a depth of 20 to 45 inches.

HEXT SERIES

The soils of the Hext series are brownish, loamy, and shallow to moderately deep. They have developed over strongly calcareous, weakly consolidated earth of Lower Cretaceous age. These strongly calcareous soils occur in small, gently sloping areas in the Hext and Saline communities.

The Hext soils are darker and lighter textured than the Brackett soils. They are not so deep as the nearby Menard soils and are more calcareous. They are browner and shallower than the Karnes soils.

Typical profile of Hext fine sandy loam in range (1.0 mile northeast of the abandoned little Saline School):

A11—0 to 8 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 3/3) when moist; weak, granular structure; hard when dry, friable when moist; few earthworm tunnels and nests and a few hard concretions of calcium carbonate; calcareous; clear boundary.

A12—8 to 12 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 3/3) when moist; structure slightly stronger than in layer above but same consistence; common films and threads of segregated calcium carbonate; calcareous; clear boundary.

B2—12 to 19 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) when moist; weak, prismatic and weak, subangular blocky structure; common films and threads of calcium carbonate; 5 percent, by volume, is hard and knobby concretions 5 to 15 millimeters in diameter; gradual boundary.

Rca—19 to 30 inches, very pale brown (10YR 7/4) loamy, calcareous earth, yellowish brown (10YR 5/4) when moist; massive (structureless); weakly cemented in upper part but less cemented as depth increases; 20 percent of soil mass is hard, knobby concretions of calcium carbonate and angular fragments of limestone; more than 50 percent is calcium carbonate.

R—30 to 50 inches, pale-yellow, weakly consolidated, sandy marl over arenaceous sandstone that has evident bedding planes.

The solum ranges from 14 to 24 inches in thickness. The A horizons range from fine sandy loam to loam in texture and from brown to reddish brown in color. The AC horizon, if present, ranges from fine sandy loam to light sandy clay loam and from reddish brown to dark brown. The upper 1 or 2 inches of the Rca horizon is weakly to moderately cemented, and the lower part grades to weakly consolidated, loamy earth. The solum has a paralithic contact with the Rca horizon. The Hext soils are of a thin family.

KARNES SERIES

The Karnes series consists of light-colored loams that have weak horizons and are rich in calcium carbonate. They occur throughout the central part of the Edwards Plateau in concave positions on foot slopes below steep slopes. The steep slopes are very strongly calcareous, loamy formations of Lower Cretaceous age. Karnes soils are not extensive in Menard County; they occur only in the eastern part. Slopes range from 2 to 5 percent.

Karnes soils are lighter colored and coarser textured than Uvalde soils. They are deeper than the shallow Brackett soils and lack the cemented Cca horizon of the darker Mereta soils.

Typical profile of Karnes loam in range (11.5 miles east of Menard and 0.3 mile south of State Route 29):

A11—0 to 8 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, very fine, subangular blocky and granular structure; hard when dry, friable when moist; few angular and rounded fragments of limestone, 5 to 10 millimeters across; calcareous; clear boundary.

A12—8 to 13 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) when moist; structure and consistence same as in layer above; few to common films and threads of calcium carbonate; few, fine, fragments of limestone; calcareous; gradual boundary.

AC1ca—13 to 32 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; moderate, very fine, subangular blocky and granular structure; hard when dry, friable when moist; common films and threads of calcium carbonate; a few concretions of calcium carbonate and fragments of limestone 5 to 20 millimeters across; calcareous; gradual boundary.

AC2ca—32 to 50 inches, very pale brown (10YR 7/4) light silty clay loam, yellowish brown (10YR 5/4) when moist; weak, granular structure; hard when dry, friable when moist; few, fine, angular and rounded fragments of limestone and a few concretions of calcium carbonate; calcareous.

The A horizons range from light gray to brown. The A11 horizon is one-half to one value darker than the A12. The AC horizons range from grayish brown to very pale brown. The solum is generally uniform in texture, but ranges from light loam to silt loam. As depth increases, there is little or no discernible change in texture. The thickness of A11 and A12 horizons combined ranges from 10 to 24 inches, and that of the AC1ca and AC2ca combined ranges from 14 to 40 inches. In places a faint "ca" horizon occurs as a few calcium carbonate concretions or threads and films. Angular and subrounded fragments of limestone, 2 millimeters to 3

inches across, make up 2 to 20 percent of the soil mass in all horizons.

KAVETT SERIES

The Kavett series consists of dark grayish-brown, shallow, calcareous silty clays; they occur on gentle slopes throughout the county.

Kavett soils are more clayey than the Mereta soils, which are underlain by cemented caliche. They are not so deep nor so clayey as Valera soils. Kavett soils have a thicker solum than Tarrant soils.

Typical profile of Kavett silty clay in a cultivated field (15.2 miles southwest of Menard and 1.25 miles east of the Lawrence Williamson ranch house):

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, subangular blocky and granular structure; hard when dry, firm but crumbly when moist; few limestone pebbles and insect tunnels; calcareous; gradual boundary.

A1 5 to 12 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate to strong, fine and very fine, subangular blocky structure; hard when dry, firm but crumbly when moist; approximately 5 percent angular limestone fragments 3 to 25 millimeters across; calcareous; gradual boundary.

B2—12 to 15 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate to strong, fine and very fine, subangular blocky structure; consistence same as in horizons above; few, fine, angular fragments of limestone 5 millimeters across; calcareous; abrupt boundary.

AC—15 to 18 inches, limestone cobbles and dark-brown calcareous earth; about equal parts of cobbles and fine earth; underside of cobbles is coated with caliche and is knobby; abrupt boundary.

R—18 to 20 inches, white, massive limestone that is softer as depth increases; upper surface coated with hard caliche 1/8 inch thick; porous.

The solum is 14 to 22 inches thick. The A horizons range from light clay to silty clay loam in texture and from dark grayish brown to dark brown in color. The AC horizon is reddish brown to dark yellowish brown. All horizons range from noncalcareous to calcareous. The structure in all horizons is moderate to strong and ranges from granular and subangular blocky to very fine blocky.

KNIPPA SERIES

The soils of the Knippa series have thick, dark A horizons of crumbly, calcareous silty clay. Silty clay extends through a thick, transitional horizon to the C horizon, which has a calcium carbonate equivalent of more than 40 percent. These soils occur on nearly level to gently sloping stream terraces throughout the county.

Knippa soils are darker colored and more clayey than the Uvalde soils. They are deeper and less crumbly than the Valera soils and are less clayey and generally deeper than Tobosa soils.

Typical profile of Knippa silty clay in a cultivated field (about 5 miles east of Fort McKavett and 200 feet south of road):

Ap—0 to 5 inches, brown (10YR 5/3) silty clay, dark brown (10YR 3/3) when moist; weak, granular structure; very hard when dry, firm but crumbly when moist; strongly calcareous; abrupt boundary.

A1—5 to 15 inches, dark grayish-brown (10YR 4/2) silty clay, dark brown (10YR 3/3) when moist; moderate, very fine, subangular blocky and blocky structure; very hard when dry, very firm when moist; strongly calcareous; gradual boundary.

AC—15 to 32 inches, brown (7.5YR 5/2) silty clay, dark brown (7.5YR 4/2) when moist; strong, very fine, blocky structure; extremely hard when dry, very firm when moist; pressure faces on peds; strongly calcareous; gradual boundary.

Cca—32 to 60 inches, pink (7.5YR 7/4) silty clay, light brown (7.5YR 6/4) when moist; moderate, very fine, blocky structure; very hard when dry, firm when moist; 5 percent, by volume, is fine, soft lumps and numerous threads of calcium carbonate; calcareous; gradual boundary.

C—60 to 72 inches, pink (7.5YR 7/4) silty clay, light brown (7.5YR 6/4) when moist; hard when dry, firm but crumbly when moist; few, fine pebbles of limestone and few, fine, soft lumps of calcium carbonate; calcareous.

The A and AC horizons range from silty clay to clay, and the Cca and C horizons range from silty clay loam to light clay. The A horizons are dark grayish brown to dark brown, and the AC horizon is reddish brown to dark brown. In microbasins of gilgai microrelief, the color of the A horizon to a depth of 8 inches has a chroma of 1 in some places. The Cca horizon is faint in some places along the San Saba River but is prominent in most areas. Depth to the Cca horizon ranges from about 24 to 44 inches. Few to many pebbles and cobbles of limestone are in the C horizon. Where the Knippa soils are in native pasture, they have weak to strong gilgai microrelief.

MENARD SERIES

The soils of the Menard series have moderately dark, fine sandy loam A horizons; reddish, sandy clay loam B horizons; free carbonates within 30 inches of the surface; and a C horizon of calcareous earth with no appreciable accumulation of calcium carbonate. These soils are inextensive in Menard County; they occur only in the loamy areas of the Hext and Saline communities.

Menard soils are finer textured throughout than the Stephenville soils. They are not so sandy nor so light colored as Nimrod soils. They are deeper than the strongly calcareous Hext soils.

Typical profile of Menard fine sandy loam in a cultivated field (0.5 mile south of the old Hext School and 1,000 feet east of a county road):

Ap—0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; structureless; hard when dry, friable when moist; few very fine particles of calcium carbonate; moderately alkaline (pH 8.0); abrupt boundary.

A11—4 to 8 inches, dark-brown (7.5YR 4/3) fine sandy loam, dark brown (7.5YR 3/3) when moist; weak, granular structure; hard when dry, friable when moist; moderately alkaline (pH 8.0); clear boundary.

B21t—8 to 14 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, prismatic and weak, blocky structure; very hard when dry, firm when moist; nearly continuous dark coating on prism faces; few fine and medium pores; mildly alkaline (pH 7.5); gradual boundary.

B22t—14 to 31 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; moderate, medium, blocky structure; very hard when dry, firm when moist; nearly continuous clay films on ped faces; neutral (pH 7.0); gradual boundary.

B3—31 to 40 inches, brown (7.5YR 5/5) sandy clay loam, dark brown (7.5YR 4/5) when moist; very hard when dry, firm when moist; few seams and threads of calcium carbonate; calcareous; gradual, wavy boundary.

C—40 to 63 inches, pink (7.5YR 8/4) sandy loam, pink (7.5YR 7/4) when moist; very hard when dry, friable when moist; very porous; 10 percent, by volume, is seams and concretions of calcium carbonate; calcareous.

The A horizons range from light fine sandy loam to loam, and the B horizons range from sandy clay loam to clay loam. The A11 horizon ranges from grayish brown to dark brown, and the B horizons range from dark brown to red or yellowish red. The A horizons range from neutral to moderately alkaline, and the B2 horizons from slightly acid to mildly alkaline. The B3 horizon is weakly to strongly calcareous. The thickness of the A horizons combined ranges from 5 to 14 inches; thickness of the B2 horizons combined ranges from 22 to 36 inches. Depth to the calcareous B3 horizon ranges from 20 to 40 inches. It averages 30 inches in Menard fine sandy loam and 24 inches in Menard loam. The C horizon contains a few water-washed pebbles and fine concretions; it ranges from weakly consolidated calcareous loamy earth to calcareous sandstone or conglomerate. Depth to the pinkish calcareous earth ranges from 30 to 60 inches and averages about 40 inches.

MERETA SERIES

The Mereta series consists of shallow, calcareous, friable soils over cemented caliche. These grayish-brown soils occur in nearly level to gently sloping old alluvium or outwash, mostly in the northern half of the county.

Mereta soils are lighter textured than the Kavett soils and are underlain by softer materials. They are not so deep as the Uvalde soils and are finer textured than the Hext soils.

Typical profile of Mereta clay loam in a cultivated field (14 miles west of Menard, 0.8 mile northwest of the Joe Russel ranch house and 500 feet north of a county road):

Ap—0 to 5 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, granular structure; hard when dry, friable when moist; calcareous; abrupt boundary.

A1—5 to 10 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, subangular blocky and blocky structure; hard when dry, friable when moist; calcareous; gradual boundary.

B2—10 to 18 inches, dark-brown (7.5YR 4/2) heavy clay loam, dark brown (7.5YR 3/2) when moist; structure and consistence same as in layer above; few caliche fragments in lower 3 inches; abrupt boundary.

Cca—18 to 20 inches, very coarse, platy, cemented caliche.

C—20 to 30 inches, pink (7.5YR 8/4) soft caliche or calcareous earth.

The texture of all horizons ranges from heavy to light clay loam or silty clay loam. The color of the A horizons ranges from dark grayish brown to brown, and that of the AC horizon, from dark brown to brown. In the AC horizon, the content of caliche fragments ranges from none to common. The caliche layer is 1 to 6 inches thick and is weakly to strongly cemented. The total thickness of the solum ranges from 12 to 24 inches.

NIMROD SERIES

The Nimrod series consists of light-colored, medium acid to slightly acid, coarse-textured soils that have a mottled subsoil. These soils developed under a forest of scrub post oak and blackjack oak on noncalcareous sand and sandy clay. They are grayish brown, loose, and nearly level to gently sloping. Nimrod soils are not extensive in Menard County; they occur on low ridges in the extreme southeastern corner of the county.

Nimrod soils are sandier than Menard soils, which have a reddish subsoil and calcareous parent material. They have a finer textured subsoil than Stephenville soils.

Typical profile of Nimrod loamy sand in a cultivated field (approximately one-fourth mile southwest of old store at Erna and 100 feet north of U.S. Highway No. 377):

Ap—0 to 6 inches, pale-brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) when moist; single grain (structureless); loose when dry, very friable when moist; wind winnowed; neutral (pH 7.0); abrupt boundary.

A1—6 to 10 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) when moist; weak, granular structure; hard when dry, very friable when moist; (pH 6.0); gradual boundary.

A2—10 to 18 inches, light-brown (7.5YR 6/4) loamy sand, brown (7.5YR 5/4) when moist; structure and consistence same as layer above; medium acid (pH 6.0); clear boundary.

B21t—18 to 24 inches, brownish-yellow (10YR 6/8) sandy clay, yellowish brown (10YR 5/8) when moist; many, coarse, prominent mottles of gray and yellowish red; moderate, very fine and fine, blocky and subangular blocky structure; very hard when dry, very firm when moist; strongly acid (pH 5.5); gradual boundary.

B22t—24 to 40 inches, mottled strong-brown (7.5YR 5/8), dark-red (2.5YR 3/6), and light brownish-gray (10YR 6/2) light sandy clay; extremely hard when dry, very firm when moist; strongly acid (pH 5.2); few, fine, quartzose pebbles; gradual boundary.

C—40 to 60 inches, mottled brownish-yellow (10YR 6/6) and red (2.5YR 4/6) light sandy clay loam; hard when dry, friable when moist; few, fine, quartzose pebbles; strongly acid (pH 5.2).

The A horizons range from loamy sand to sand. The A2 horizon ranges from grayish brown to dark brown. The B2 horizons range from gray to dark yellowish brown and have faint to distinct mottles of gray, yellowish red, red, and pale olive. The thickness of the A horizons combined ranges from 15 to 30 inches. The B2 horizons range in pH from 5.0 to 6.0. In places beds of quartzose pebbles occur at a depth of 2 to 4 feet.

STEPHENVILLE SERIES

The soils of the Stephenville series have a brownish loamy fine sand surface layer and a reddish, friable sandy clay loam subsoil. These soils are not extensive in Menard County; they occur only in loamy areas in the Hext and Saline communities. In Menard County Stephenville soils occur over sandy clay and sandstone.

Stephenville soils have a redder subsoil than that of the Nimrod soils, which is mottled. They are sandier and have a deeper solum than Menard soils.

Typical profile of Stephenville loamy sand in a cultivated field (0.5 mile southwest of the old store at Erna and 100 feet northwest of U.S. Highway No. 377):

Ap—0 to 5 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) when moist; single grain (structureless); soft when dry, very friable when moist; medium acid (pH 6.0); abrupt boundary.

A11—5 to 10 inches, grayish-brown (10YR 5/2) loamy sand, dark brown (10YR 3/3) when moist; weak, granular structure; very hard when dry, very friable when moist; somewhat compact; medium acid (pH 6.0); gradual boundary.

A12—10 to 15 inches, dark-brown (7.5YR 4/2) loamy sand, dark brown (7.5YR 3/2) when moist; weak, granular structure; hard when dry; very friable when moist; medium acid (pH 6.0); gradual boundary.

B21t—15 to 22 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; moderate, fine, blocky structure; very hard when dry, friable when moist; medium acid (pH 6.0); gradual boundary.

B22—22 to 50 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) when moist; moderate, very fine and fine, blocky structure; extremely hard when dry, very firm when moist; (pH 5.8); gradual boundary.

C—50 to 60 inches, brownish-yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) when moist; very hard when dry, firm to friable when moist; few fine concretions of calcium carbonate; calcareous.

The A horizons combined range from 12 to 18 inches in thickness, and the B2 horizons combined range from 16 to 35 inches. In color the Ap horizon ranges from dark grayish brown to brown, the A11 and A12 range from dark brown to light brown, the B2 horizon from red to yellowish red, and the C horizon from yellowish red to brownish yellow. In pH, the A horizons range from 7.0 to 6.0 and the B horizons from 5.5 to 6.0. The C horizon ranges from pH 6.0 to calcareous. Mottles occur in the lower part of the B horizon. In places calcareous material occurs within 60 inches of the surface. Quartz pebbles in the B horizons are few to abundant. The C horizon ranges from sandy clay loam to sandy clay.

TARRANT SERIES

The Tarrant series consists of dark-colored, very thin, crumbly soils that developed over hard limestone. These soils are extensive throughout the eastern part of the Edwards Plateau; they make up about 75 percent of the county. Tarrant soils are gently sloping to undulating and steep; slopes range from 1 to 20 percent.

Tarrant soils are darker than the Brackett soils, which are underlain by soft, limy earth. They are not so deep as Kavett soils, which are shallow.

Typical profile of Tarrant angular cobbly clay (3.0 miles south of Menard and 300 feet west of U.S. Highway No. 83):

A11—0 to 6 inches, very dark grayish-brown (10YR 3/2) light clay, very dark brown (10YR 2/2) when moist; moderate, very fine, subangular blocky and granular structure; hard when dry, firm when moist; about 20 percent, by volume, is angular cobbles of limestone; calcareous; clear boundary.

A12—6 to 9 inches, light clay similar to layer above; about 85 percent, by volume, is loose, angular pebbles of limestone; abrupt boundary.

R—9 to 24 inches, hard, fractured limestone; cracks are few in upper 10 inches and are filled with fine material similar to fine material in layer above.

The thickness of the A11 horizon ranges from 2 to 10 inches and averages about 6 inches. This horizon ranges from clay to silty clay loam in texture and from very dark brown to very dark grayish brown in color. It is noncalcareous or calcareous. The A12 horizon is 2 to 4 inches thick. Coarse fragments of limestone cover from 0 to 50 percent of the surface of Tarrant soils and, in the profile, make up from 0 to 50 percent of the soil mass. Depth to fractured bedrock ranges from 4 to 12 inches. The bedrock is massive limestone that ranges from hard to soft.

TOBOSA SERIES

The Tobosa series consists of deep, brownish, calcareous clays that developed over limestone on the Edwards Plateau. These dark grayish-brown clays are not extensive in Menard County; the largest areas occur in the Hext and Saline communities and are nearly level to gently sloping.

Tobosa soils are more clayey than Knippa soils. They are deeper and are less crumbly than Valera soils and are more clayey and less crumbly than Uvalde soils.

Typical profile of Tobosa clay in range (1.5 miles north of the old store at Erna and one-fouth mile west of the Mason County line):

A11 0 to 5 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; moderate, very fine and fine, subangular blocky and blocky structure; hard when dry, firm when moist, sticky and plastic when wet; calcareous; few fine fragments of limestone; many fine grass roots; gradual boundary.

A12—5 to 30 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; moderate, fine, blocky structure; very hard when dry, very firm when moist, sticky and plastic when wet; shiny ped surfaces and pressure faces; calcareous; gradual boundary.

AC1—30 to 45 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; structure and consistence same as layer above; few fine fragments of limestone and few specks of calcium carbonate in lower 5 inches; calcareous; clear boundary.

AC2ca—45 to 50 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) when moist; common fine seams and specks of calcium carbonate; abrupt boundary.

R—50 to 55 inches, hard fractured limestone.

The thickness of the A horizons combined ranges from 14 to 36 inches. In color, the A11 horizon ranges from dark grayish brown to black, the A12 horizon from very dark brown to dark grayish brown, and the AC1 horizon from grayish brown to dark grayish brown. In many soil profiles, the AC2ca horizon is lacking. The depth to limestone ranges from 24 to 55 inches. Areas of this soil in range have moderate gilgai microrelief in places.

UVALDE SERIES

The Uvalde series consists of grayish-brown, crumbly, moderately fine textured soils that are rich in calcium carbonate. They are mainly on stream terraces in Menard County. Uvalde soils are not extensive in the county, but they occur throughout along both large and small streams. They are nearly level to gently sloping.

Uvalde soils are darker and more clayey than the Karnes soils. They are less clayey and more crumbly than the Knippa soils. Uvalde soils are lighter colored than Valera soils, which are over limestone bedrock.

Typical profile of Uvalde silty clay loam in a cultivated field (9.5 miles west of Menard and 100 feet south of State Route 29):

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; slightly hard when dry, friable when moist; calcareous; abrupt boundary.

A11—6 to 14 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, subangular blocky structure; hard when dry, firm but crumbly when moist; calcareous; gradual boundary.

A12—14 to 22 inches, brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) when moist; very fine, subangular blocky structure; hard when dry, firm when moist; calcareous; few very fine pebbles; gradual, wavy boundary.

Bca—22 to 32 inches, light-brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) when moist; structure and consistence same as in layer above; common, fine, hard and soft lumps and hard, knotty concretions of calcium carbonate; gradual boundary.

Cca—32 to 56 inches, pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) when moist; consistence same as in layer above; many, pinkish-white, soft and hard concretions of calcium carbonate that are 1 to 15 millimeters in diameter and make up an estimated 50 percent of horizon, by volume.

C—56 to 64 inches, pink (7.5YR 8/4) limy earth, pink (7.5YR 7/4) when moist; hard when dry, slightly hard when moist; few concretions and lumps of segregated calcium carbonate; calcareous.

The A horizon ranges from heavy silty clay loam to light silty clay loam. Its consistence is friable to firm. The thickness of the surface and subsurface horizons combined ranges from 18 to 38 inches. When dry, the A11 horizon ranges from dark brown to dark grayish brown and the A12 horizon from brown to dark brown. The C horizons range from light brown to white. Concretions and lumps of lime in the Cca horizon are many or numerous. In places where Uvalde soils are near terrace escarpments, the A11 and A12 horizons contain thin layers of rounded pebbles.

VALERA SERIES

The Valera series consists of moderately deep, dark grayish-brown, crumbly soils that developed over hard limestone or caliche. These calcareous, fine-textured soils occur throughout the county on gentle slopes of shallow valleys and limestone uplands. In many areas the underlying material is a bed of limestone cobbles and angular pebbles several inches thick.

Valera soils are deeper than the Kavett and Tarrant soils. They are less clayey and more crumbly than the Tobosa soils. The Knippa and Uvalde soils lack a petrocalcic horizon like that in Valera soils.

Typical profile of Valera silty clay in native range (in the extreme northwestern part of the county, 540 feet south of a gravel road at a point 20.3 miles from its intersection with State Route 29, which is 7.5 miles west of U.S. Highway No. 83):

A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) when moist; moderate, very fine, subangular blocky and granular structure; hard when dry, firm but crumbly when moist, sticky and plastic when wet; few, fine, angular fragments of limestone as much as 1 centimeter across; many fine roots; calcareous; clear boundary.

A12—5 to 11 inches, dark-brown (7.5YR 3/2) light clay, dark brown (7.5YR 3/2) when moist; moderate, very fine, subangular blocky structure; consistence same as in layer above; few roots; few angular fragments of limestone; calcareous; gradual boundary.

B2—11 to 19 inches, brown (7.5YR 4/2) light clay, dark brown (7.5YR 4/2) when moist; moderate, fine, subangular and few, very fine, angular blocks; very hard when dry, firm but crumbly when moist; peds contain many fine pores; few angular fragments of limestone and few fine concretions of calcium carbonate in lower part; moderately alkaline; calcareous; gradual boundary.

C1ca—19 to 27 inches, light-brown (7.5YR 6/4) light silty clay, brown (7.5YR 5/4) when moist; moderate, fine, subangular blocky structure; very hard when dry, firm when moist, slightly sticky and plastic when wet; soft lumps and threads and knobby strongly cemented concretions of calcium carbonate make up about 5 percent of horizon, by volume; few hard cobbles and angular pebbles of limestone coated with caliche; calcareous.

C2cam—27 to 31 inches, pinkish and whitish indurated caliche in which few solution channels and fractures occur and are filled with limy earth and earthworm casts; clear boundary.

C3 & R—31 to 54 inches +, about 60 percent of limestone cobbles and flags coated with caliche and stratified or interbedded with reddish-yellow (5YR 6/6) light silty clay loam, yellowish red (5YR 5/6) when moist; angular pebbles of partly weathered limestone; common, fine, strongly cemented concretions of calcium carbonate; calcareous.

The surface layer ranges from clay to silty clay loam. The A11 and A12 horizons range from grayish brown to dark brown, and the B2 horizon ranges from dark brown to yellowish brown. The structure of the B2 horizon is very fine subangular blocky or angular blocky. The B2 horizon is noncalcareous or calcareous. Depth to the C2cam horizon ranges from 20 to 40 inches. In some places the layer of limestone cobbles and flags is absent, and in many places this layer is much thinner than the layer described in the typical profile.

General Nature of the Area

In this section information is provided for those who wish to get a general idea of the county. Briefly discussed are the geology, climate, early history, and agriculture of the county and other subjects of general interest.

Geology [4]

In Menard County the formation of soils, the supply of underground water, and the production of gas and oil are associated with five geologic systems (fig. 15). From the oldest to the youngest, these systems are the Ordovician, Pennsylvanian, Permian, Cretaceous, and Quaternary (*3*). In all the systems except the Quaternary, the rocks were deposited in sea water and later were covered by other sediments. The rocks are in layers that generally are of uniform thickness. In the Cretaceous and Quaternary systems, the rock layers are generally flat, but in the other systems, they dip to the west at an average rate of 50 feet per mile.

The Ordovician system is represented by Ellenburger limestone. The hard limestone of this group is at an average depth of 3,000 feet in Menard County and is unimportant in the formation of soils or as a source of water.

The Pennsylvanian system is about 2,400 feet thick. It immediately overlies the Ordovician system and consists of thick beds of shale separated by thinner beds of limestone or sandstone. In this county the system has not cropped out enough to permit the development of soils characteristic of the Pennsylvanian formation. It does not offer a dependable source of water, but it is an important producer of gas and oil in the western part of the county.

[4] By W. G. Groce, geologist, Soil Conservation Service.

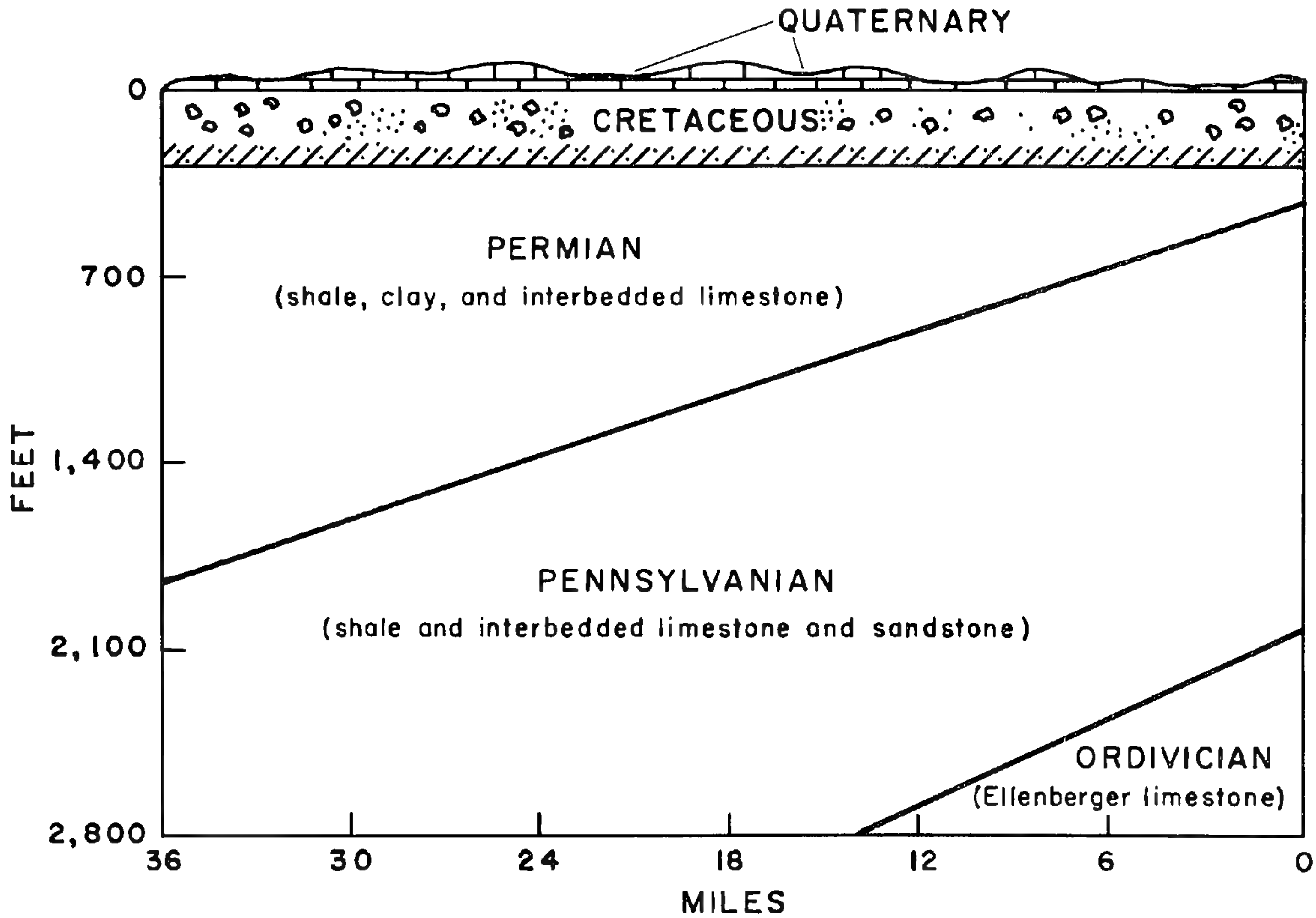

Figure 15.—Geologic section across Menard County.

The Permian formation is about 500 feet thick and consists of alternating layers of shale, clay, and limestone. The only outcrops of this formation are small areas that were exposed by the downcutting of the San Saba River. This system is unimportant in soil formation or as a reservoir for underground water.

The Cretaceous system is about 200 to 400 feet thick in Menard County. All the soils in the county have formed over or in materials of this system. The rocks consist of three layers, all of which contain some highly mineralized water. The lowest or oldest layer consists of red and gray sandy clay and plastic clay. This sandy clay has partly contributed to the formation of the Menard, Nimrod, and Stephenville soils. The middle layer of the Cretaceous system varies widely in composition. It consists mainly of soft marl but, in some places, contains thick beds of sand, of shell conglomerate, and of limestone. This layer has contributed to the formation of the Brackett, Karnes, and Hext soils. The upper layer of the Cretaceous system is limestone. It ranges from one foot to several feet in thickness and from hard to cherty. In places the limestone is interbedded with marl. Valera, Tarrant, and Tobosa soils formed over this layer. Most of the county's water supply for livestock and domestic use comes from Cretaceous limestone. Most of the water for municipal use and for irrigation comes from the San Saba River, which is fed by springs that are in the Cretaceous limestone formation.

The Quaternary system consists of alluvium and occurs on the flood plains of the San Saba River and its larger tributaries. Among the soils formed in this alluvium are the Frio, Uvalde, and Knippa.

Climate [5]

The climate of Menard County is semiarid; warm, dry weather predominates. The average annual rainfall is 21.68 inches. Monthly and annual rainfall are extremely variable. Annual rainfall has ranged from 7.64 inches in 1951 to 37.45 inches in 1935. Also, on the average, the county receives only about 10 inches of rainfall in 1 year out of every 10, but it also receives about 30 inches, or three times as much, in 1 year out of every 10. Since weather observations began in 1889, the driest period recorded in the county was during the severe drought in the period from 1951 to 1956. Except for

[5] By ROBERT B. ORTON, State climatologist, U.S. Weather Bureau.

TABLE 7.—*Summary of precipitation data at Menard, Menard County, Tex.*[1]

[Elevation, 1,960 feet]

Month	Average monthly	Maximum daily		Driest year (1951)	Wettest year (1935)	1 year in 10 will have—		Average number of days having precipitation less than—			Snowfall		
						Less than—	More than—	0.10 inch	0.50 inch	1.00 inch	Average	Maximum monthly	
	Inches	*Inches*	*Year*	*Inches*	*Inches*	*Inches*	*Inches*				*Inches*	*Inches*	*Year*
January	1.07	1.67	1944	(2)	1.34	0.1	2.4	2	(3)	(3)	0.8	7.0	1944
February	1.06	2.22	1949	0.35	3.17	.1	2.2	2	1	(3)	.3	4.0	1961
March	.89	1.85	1934	1.00	.72	.1	1.9	1	(3)	0	.2	5.7	1947
April	2.20	3.84	1944	.58	1.21	.5	4.1	4	1	1	0	0	--------
May	3.06	3.48	1956	1.54	6.90	.8	5.3	4	2	1	0	0	--------
June	2.48	3.18	1961	1.38	4.63	.4	4.9	3	1	1	0	0	--------
July	1.92	4.40	[4] 1938	.08	3.45	0	3.5	2	1	(3)	0	0	--------
August	1.77	4.70	1942	2.08	2.44	.1	3.3	2	1	(3)	0	0	--------
September	3.17	6.03	1936	.25	9.96	.2	6.9	3	1	1	0	0	--------
October	2.15	4.07	1944	.14	1.62	.1	4.4	4	2	1	0	0	--------
November	.91	1.04	1955	.18	.94	0	2.5	3	1	(3)	.4	7.0	1957
December	1.00	2.97	1937	.06	1.07	.1	1.6	2	(3)	(3)	.1	3.3	1946
Year	21.68	6.03	1936	7.64	37.45	10.2	30.3	32	11	5	1.8	7.0	[4] 1957

[1] Average length of record is 30 years, 1933–62, except for average number of days having precipitation of 0.10, 0.50, and 1.00 inch, which is 10 years.

[2] Trace.

[3] Less than one-half day.

[4] Also occurred on dates earlier than that shown.

the year 1952, less than 15 inches of rain fell each year. The average annual rainfall for that 6-year period was only 12.98 inches. Following the drought there was a wet period in which there was an average rainfall of 23.42 inches for the 5 years 1957–61. In 1962 the amount of rainfall again dropped sharply.

Precipitation data for Menard County are summarized in table 7. Rainfall occurs more frequently in thunderstorms than in general rains. This shower type of rainfall is spotty and accounts for the large variation in amounts in local areas and at different times. Much of the rain during wet years falls in heavy showers over short periods, and a large percentage of the water is lost as runoff. Approximately two-thirds of the average annual rainfall occurs during the 6-month period from May through October. As in most of southwest Texas, the heaviest rainfall usually occurs in September, though the difference between the amount in May and in September is small. The heaviest 24-hour rainfall on record occurred in September 1936. The largest monthly total, 14.86 inches, fell in July 1938, which is larger than the total annual rainfall in some years. Periods without rain for several weeks or more are common, and periods of 30 days or more without rain have occurred at one time or another.

Precipitation in winter falls as snow, rain, sleet, or a combination of these. Snowfall is generally light and of little consequence. Freezing rain, which sometimes comes during cold spells in winter and spring, often is disastrous to freshly shorn sheep and goats and to spring lambs and kids.

Temperature changes may be rapid and frequent during the colder months, November through April, as cold fronts move through the county from the north and from the west. The daytime temperatures in summer are generally high; on the average, about 115 days have a maximum temperature of 90° F. or above. However, the humidity is low and moderates the effect of the daytime heat and results in rapid cooling after sundown. Most nights are pleasant, as minimum temperatures are in the upper 60's and low 70's in summer. The dry air and generally clear skies result in a large daily change in temperature.

The relative humidity in the county is low; it averages about 60 percent annually. The highest humidity occurs during the early morning just before sunrise. At 6:00 a.m. the average relative humidity is a little more than 70 percent the year round, and at 6:00 p.m. the average is about 40 percent. Sunshine is abundant during all months, but the most cloudiness occurs during the latter part of winter and early in spring.

Evaporation is high, as is expected in a semiarid region. The average annual evaporation from 48-inch Weather Bureau pans is approximately 100 inches, and the average evaporation from a lake is approximately 69 inches annually.

Although strong northerly winds accompany cold fronts through Menard County in winter, the prevailing winds are from the south during all seasons. The average annual velocity of wind is about 10 miles per hour.

The length of the growing season (freeze-free period) in Menard County is about 222 days, though considerable variation is likely from place to place. The average date of the last occurrence of 32° F. in spring is March 31, and the average date of the first occurrence of 32° in fall is November 8. On the average, about 1 year in 5 will have a freeze after April 15, and about 1 year in 20, after April 25. Also, in about 1 year in 5, a freeze will occur before November 1, and in 1 year in 20, before October 17. The average number of days between the last occurrence of 28° in spring and the first occurrence in fall is 245 days.

Natural Resources

Soil and grass are two of the most important natural resources of Menard County. Cattlemen from early days have prized the limestone hills of the Edwards Plateau for their strong native grasses and favorable climate. In about 83 percent of the county, the soils are very shallow or stony and are suitable only as grassland. About 94 percent of the county has always been in grass.

Oil and gas have recently been discovered in the county and are promising natural resources.

Water suitable for irrigation is another natural resource. Although this water is limited in quantity, it is important to crop production. All the irrigation water now comes from the San Saba River, which is fed by springs and flows the year round. Most of the springs are located at the head of the river, just west of Menard County.

The wildlife in Menard County is profitable to landowners. Deer, turkeys, quail, and doves provide an abundance of hunting. The sale of hunting leases brings nearly as much profit to some landowners as the sale of livestock.

Early History, Development, and Population

The area that is now Menard County was the hunting ground of Comanche and Apache Indians until late in the 1800's. The county was formed from Bexar Territory in 1858 and was formally organized in 1871. Menard County was named for Michael B. Menard, the founder of Galveston, Tex. The town of Menard, the county seat, was established in 1881, when its population was less than 60 people.

San Saba Mission and a presidio were established in the spring of 1757 near the present site of Menard. Indians destroyed the mission in 1758, and it was never rebuilt. The presidio was abandoned in 1770. Fort McKavett, an army post in the western part of the county, was built in 1852 for protection against Indians. Ruins of this fort still stand.

Livestock ranching has always been the main farming enterprise in Menard County. Less than 4 percent of the county is cultivated. The present trend in land use is a change from cropland to grassland; most cropland is now planted to crops for grazing and for feed. Irrigation farming has been practiced in the bottom lands along the San Saba River since the early days of settlement. As much as 7,000 acres along the river was once irrigated, but today the river supplies water to irrigate about 2,000 acres of grain sorghum, oats, wheat, alfalfa, pecans, and grasses.

In 1945 the ranchers and farmers of Menard County formed the Menard County Soil Conservation District to assist landowners in conserving their soil and water resources. The district occupies about 530,000 acres of the county; the rest of the county is part of the Concho Soil Conservation District.

The population of Menard County has decreased steadily during the last 20 years. In 1940, there were about 4,500 people in the county; in 1950, about 4,200; and in 1960, only about 3,000. More than two-thirds of the people live in the vicinity of Menard and Fort McKavett.

Agriculture

According to the 1959 Census of Agriculture, there were 275 ranches and farms in the county in 1959 and 325 farms in 1954. The average size of farms was 2,098 acres in 1959, which was 240 acres larger than the size in 1954. Also, according to the census, there were 1,825 acres irrigated in 1959, or about 700 acres fewer than in 1954. In 1959 about 73 percent of the landowners lived on their land. Only about 17 percent of the farms and ranches were operated by tenants. The average age of landowners in 1959 was about 56 years.

The 1959 census reported that the acreage of crops harvested was 236 acres of corn, 857 acres of sorghum for grain, 179 acres of wheat, 1,970 acres of oats for grain, 548 acres of barley, 211 acres of alfalfa, and 498 acres of cotton. More than 220 acres of orchards, trees, and vineyards were reported. About 3,580 trees were improved pecan trees, and about 19,600 were native pecan trees.

Transportation and Markets

Menard County can be reached from almost any direction by good highways. Farm products are transported mostly by motortruck. The Santa Fe Railroad runs into Menard from Brady and carries freight to and from the town of Menard. U.S. Highways Nos. 83 and 377, State Route 29, Ranch Roads 864, 42, 1221, 1773, 1674, 1311, and 2291, and Farm Road 2092 provide automobile and truck routes to markets. Graveled and caliche-surfaced roads that are maintained by the county are well distributed over most areas.

Most livestock are sold at auction in Menard and at other sales in nearby counties. Large sales are made at markets in San Angelo, Fort Worth, and San Antonio. Wool and mohair are sold both locally and to outside buyers. Most of the crops are used locally. Pecans are usually sold on the tree to buyers who harvest the nuts and ship them to the shellers.

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Glossary

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Hard grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are

Loose. Noncoherent; soil will not hold together in a mass.

Friable. When moist, soil crushes under moderate pressure between thumb and forefinger but resistance is distinctly noticeable.

Firm. When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic. When wet, soil is readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky. When wet, soil adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard. When dry, soil is moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft. When dry, soil breaks into powder or individual grains under very slight pressure.

Cemented. Brittle, hard consistence caused by a cementing substance other than clay minerals.

Genesis, soil. The manner in which the soil originated. In describing the genesis of a soil, special reference is given to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes and that differs in one or more ways from adjacent horizons in the same profile.

Marl. An earthy, unconsolidated deposit in fresh-water lakes that consists chiefly of calcium carbonate mixed with various amounts of clay or other impurities.

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons that make up the soil profile.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size of measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Outwash. Stratified material that is washed out and deposited on a plain.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Poorly graded. A soil material consisting mainly of particles nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words, the degree of acidity or alkalinity is expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in a soil that have diameters ranging from 0.05 millimeter to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural clay name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. In soils having distinct profiles, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C or R horizon.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so that they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. (See also clay, sand, and silt.) The basic textural classes in order of increasing proportions of fine particles are as follows: Sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

GUIDE TO MAPPING UNITS

[See table 1, p. 6, for approximate acreage and proportionate extent of soils; see table 2, p. 26, for predicted acreage yields of the major crops; see tables 3, 4, and 5, p. 30, p. 34, and p. 36, respectively, for engineering properties and interpretations of the soils]

Map symbol	Soil	Page	Capability unit: Dryland	Page	Capability unit: Irrigated	Page	Range site: Name	Page
BaC	Brackett soils, 2 to 5 percent slopes	7	IVe-2	24	None		Adobe	20
Ds	Dev soils	7	VIw-1	24	None		Valley	18
FcA	Frio clay loam, 0 to 1 percent slopes	7	IIc-1	23	I-1	22	Bottom-land	19
FcB	Frio clay loam, 1 to 2 percent slopes	8	IIe-1	23	IIe-1	23	Bottom-land	19
Fr	Frio soils, frequently flooded	8	Vw-1	24	None		Bottom-land	19
Fs	Frio soils, shallow variants	8	IIe-1	23	None		Valley	18
HfC	Hext fine sandy loam, 2 to 5 percent slopes.	9	IVe 1	24	None		Sandy Loam	19
KaB	Kavett silty clay, 0 to 3 percent slopes	10	IIIe-3	23	None		Shallow	19
KnC	Karnes loam, 2 to 5 percent slopes	10	IIIe-2	23	None		Valley	18
KpA	Knippa silty clay, 0 to 2 percent slopes.	11	IIIe-1	23	IIe-1	23	Valley	18
MaB	Menard fine sandy loam, 1 to 3 percent slopes.	11	IIe-2	23	None		Sandy Loam	19
MaC	Menard fine sandy loam, 3 to 5 percent slopes.	11	IIIe-4	23	None		Sandy Loam	19
MnA	Menard loam, 0 to 2 percent slopes	12	IIe-2	23	None		Sandy Loam	19
MrA	Mereta clay loam, 0 to 2 percent slopes	12	IIIe-3	23	None		Shallow	19
NdB	Nimrod loamy sand, 0 to 3 percent slopes.	12	IIIe-5	23	None		Sandy	20
Rb	Rough broken land	12	VIIe-1	25	None		Rough Eroded Breaks	21
StB	Stephenville loamy sand, 0 to 3 percent slopes.	13	IIIe 5	23	None		Sandy	20
Ta	Tarrant soils, undulating	13	VIs-1	24	None		Low Stony Hills	17
Tb	Tarrant-Brackett association, hilly	14						
	Tarrant soil		VIs-2	24	None		Low Stony Hills	17
	Brackett soil		VIs-2	24	None		Adobe	20
Tk	Tarrant-Kavett complex, nearly level	14						
	Tarrant soil		VIs-1	24	None		Low Stony Hills	17
	Kavett soil		VIs-1	24	None		Shallow	19
Tr	Terrace escarpments	14	VIs-3	24	None		Rough Eroded Breaks	21
TsA	Tobosa clay, 0 to 1 percent slopes	15	IIIs-1	24	None		Valley	18
TsB	Tobosa clay, 1 to 3 percent slopes	15	IIIe-1	23	None		Valley	18
UaA	Uvalde silty clay loam, 0 to 1 percent slopes.	15	IIc-1	23	I-1	22	Valley	18
UaB	Uvalde silty clay loam, 1 to 3 percent slopes.	16	IIe-1	23	IIe-1	23	Valley	18
VaB	Valera silty clay, 0 to 3 percent slopes	16	IIe-1	23	IIe-1	23	Valley	18

U.S. GOVERNMENT PRINTING OFFICE: 1966

ERRATA

SOIL SURVEY OF MENARD COUNTY, TEXAS

Page 18. In figure 13, the photo at the top belongs at the bottom.

Page 47. In figure 15, "Ordovician," not "Ordivician."

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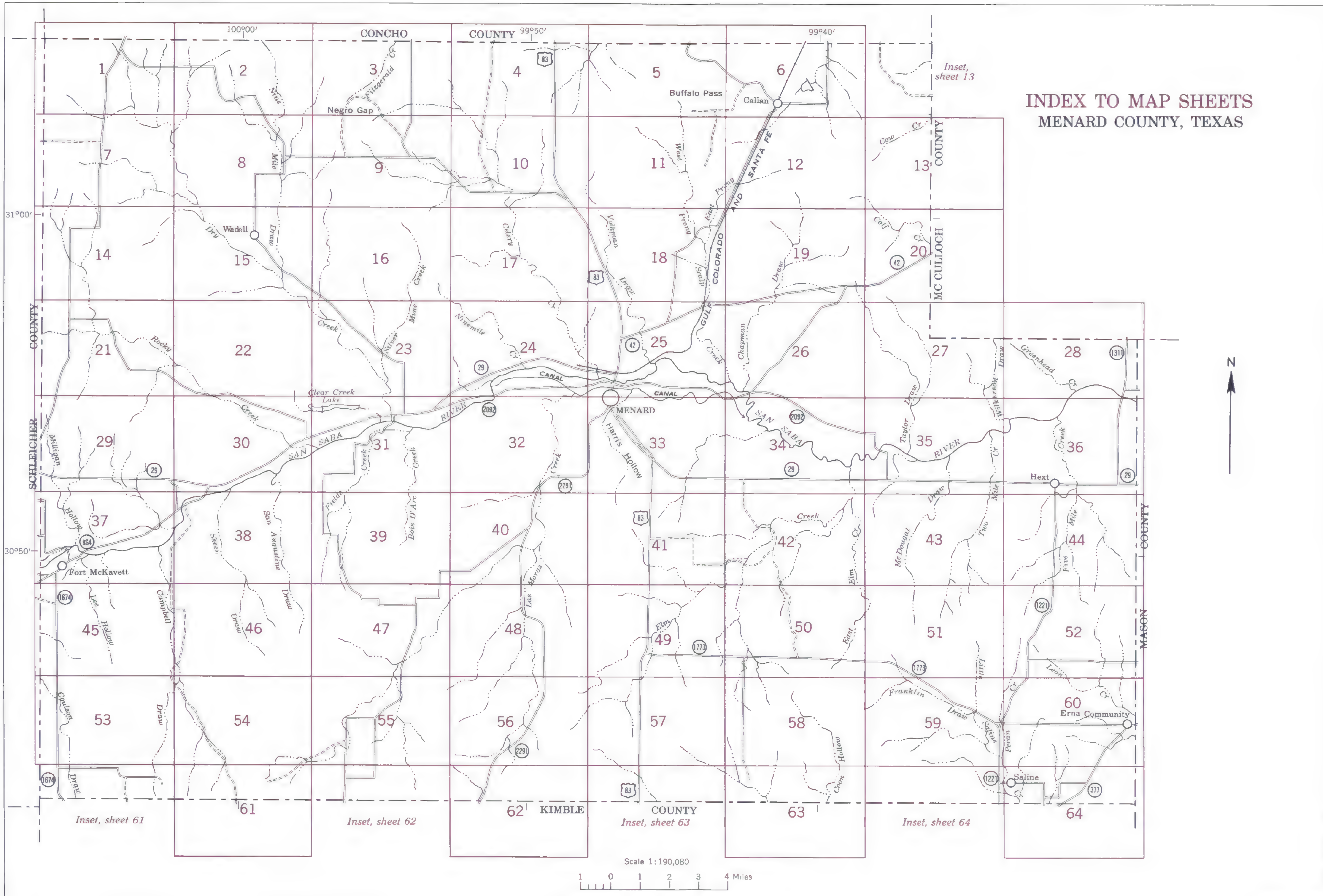
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION
GENERAL SOIL MAP
MENARD COUNTY, TEXAS
SOIL ASSOCIATIONS
1 Menard-Hext association: Deep, loamy soils of the uplands
2 Tarrant association: Very shallow soils of the limestone uplands
3 Knippa-Uvalde association: Deep, fine textured and moderately fine textured soils of the stream terraces
4 Frio-Uvalde association: Deep, moderately fine textured soils on flood plains and terraces
January 1966
CONCHO COUNTY
SCHLEICHER COUNTY
MC CULLOCH COUNTY
MASON COUNTY
KIMBLE COUNTY
MENARD
Fort McKavett
Hext
Saline
Erna Community
Callan
Wadell
Buffalo Pass
Negro Gap
Clear Creek Lake
SAN SABA RIVER
CANAL
GULF COLORADO AND SANTA FE
Scale 1:190,080
1 0 1 2 3 4 Miles



INDEX TO MAP SHEETS
MENARD COUNTY, TEXAS
CONCHO COUNTY
MC CULLOCH COUNTY
MASON COUNTY
KIMBLE COUNTY
SCHLEICHER COUNTY
100°00′
99°50′
99°40′
31°00′
30°50′
Inset, sheet 13
Inset, sheet 61
Inset, sheet 62
Inset, sheet 63
Inset, sheet 64
Buffalo Pass
Callan
Negro Gap
Wadell
MENARD
Hext
Fort McKavett
Erna Community
Saline
Clear Creek Lake
SAN SABA RIVER
CANAL
GULF COLORADO AND SANTA FE
N
Scale 1:190,080
1 0 1 2 3 4 Miles

SOIL LEGEND

The first capital letter is the first one of the soil name. A second capital letter, A, B, or C, shows the slope. Most symbols without a slope letter are for nearly level soils or land types, but some are for soils or land types that have considerable range in slope.

SYMBOL	NAME
BaC	Brackett soils, 2 to 5 percent slopes
Ds	Dev soils
FcA	Frio clay loam, 0 to 1 percent slopes
FcB	Frio clay loam, 1 to 2 percent slopes
Fr	Frio soils, frequently flooded
Fs	Frio soils, shallow variants
HfC	Hext fine sandy loam, 2 to 5 percent slopes
KaB	Kavett silty clay, 0 to 3 percent slopes
KnC	Karnes loam, 2 to 5 percent slopes
KpA	Knippa silty clay, 0 to 2 percent slopes
MaB	Menard fine sandy loam, 1 to 3 percent slopes
MaC	Menard fine sandy loam, 3 to 5 percent slopes
MnA	Menard loam, 0 to 2 percent slopes
MrA	Mereta clay loam, 0 to 2 percent slopes
NdB	Nimrod loamy sand, 0 to 3 percent slopes
Rb	Rough broken land
StB	Stephenville loamy sand, 0 to 3 percent slopes
Ta	Tarrant soils, undulating
Tb	Tarrant–Brackett association, hilly
Tk	Tarrant–Kavett complex, nearly level
Tr	Terrace escarpments
TsA	Tobosa clay, 0 to 1 percent slopes
TsB	Tobosa clay, 1 to 3 percent slopes
UaA	Uvalde silty clay loam, 0 to 1 percent slopes
UaB	Uvalde silty clay loam, 1 to 3 percent slopes
VaB	Valera silty clay, 0 to 3 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church

Forest fire or lookout station

Mines and Quarries

Mine dump

Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks, oil or gas

Oil or gas well

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Land division corners

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches — CANAL, DITCH

Lakes and ponds
- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

Soil boundary and symbol — Dx

Gravel

Stones

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

Gullies

WORKS AND STRUCTURES, continued

Fence

Fence on road

Fence on county line

Windmills

Soil map constructed 1965 by Cartographic Division, Soil Conservation Service, USDA, from 1963 aerial photographs. Controlled mosaic based on Texas plane coordinate system, central zone, Lambert conformal conic projection, 1927 North American datum.

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

2


N
CONCHO COUNTY
Ta
Tk
VaB
UaA
Nine
Mile
Draw
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 8)
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

3

N

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 9)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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(4)

(Joins sheet 10)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

MENARD COUNTY, TEXAS — SHEET NUMBER 5

5

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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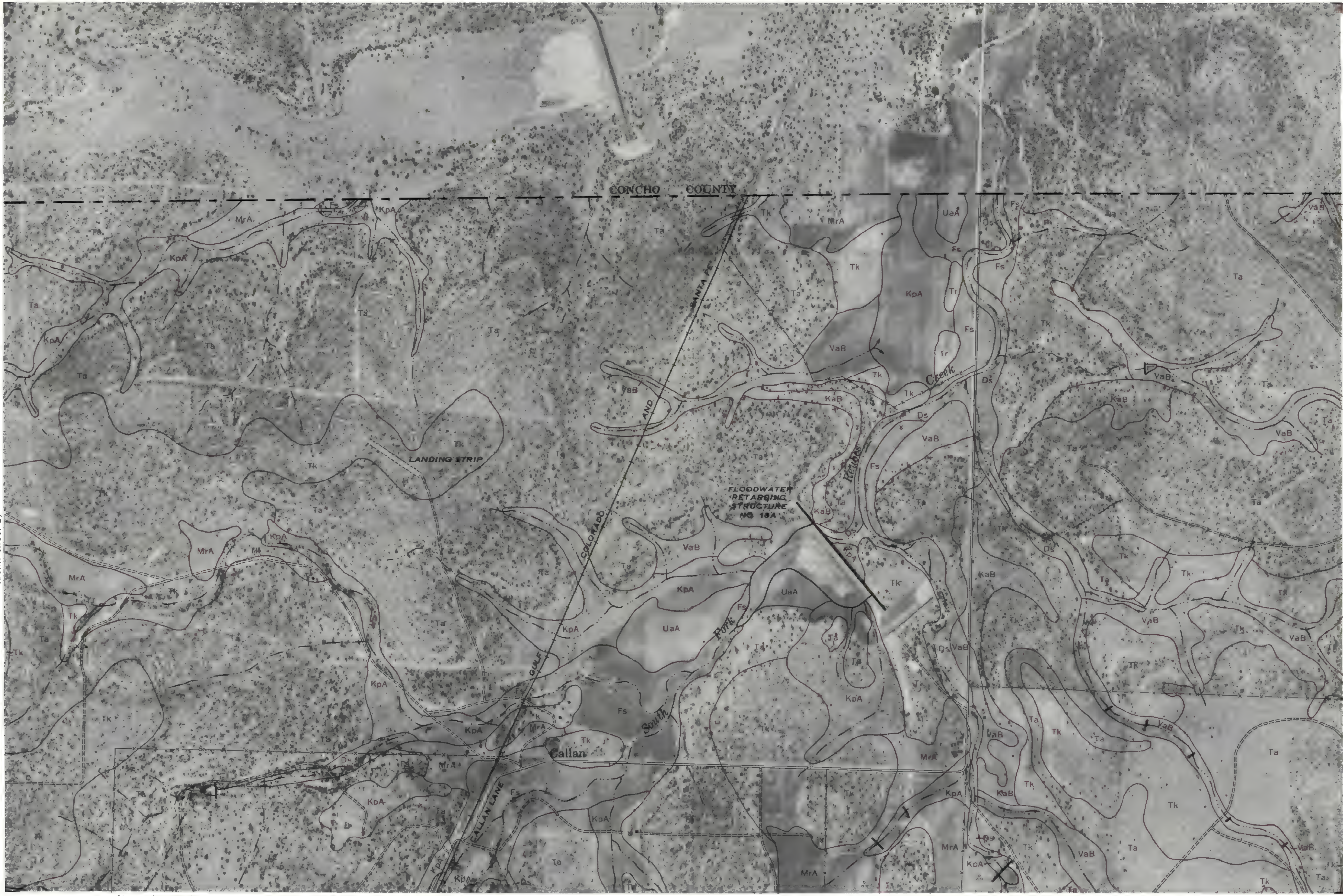
6

N

(Joins sheet 5)



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(Joins sheet 12)

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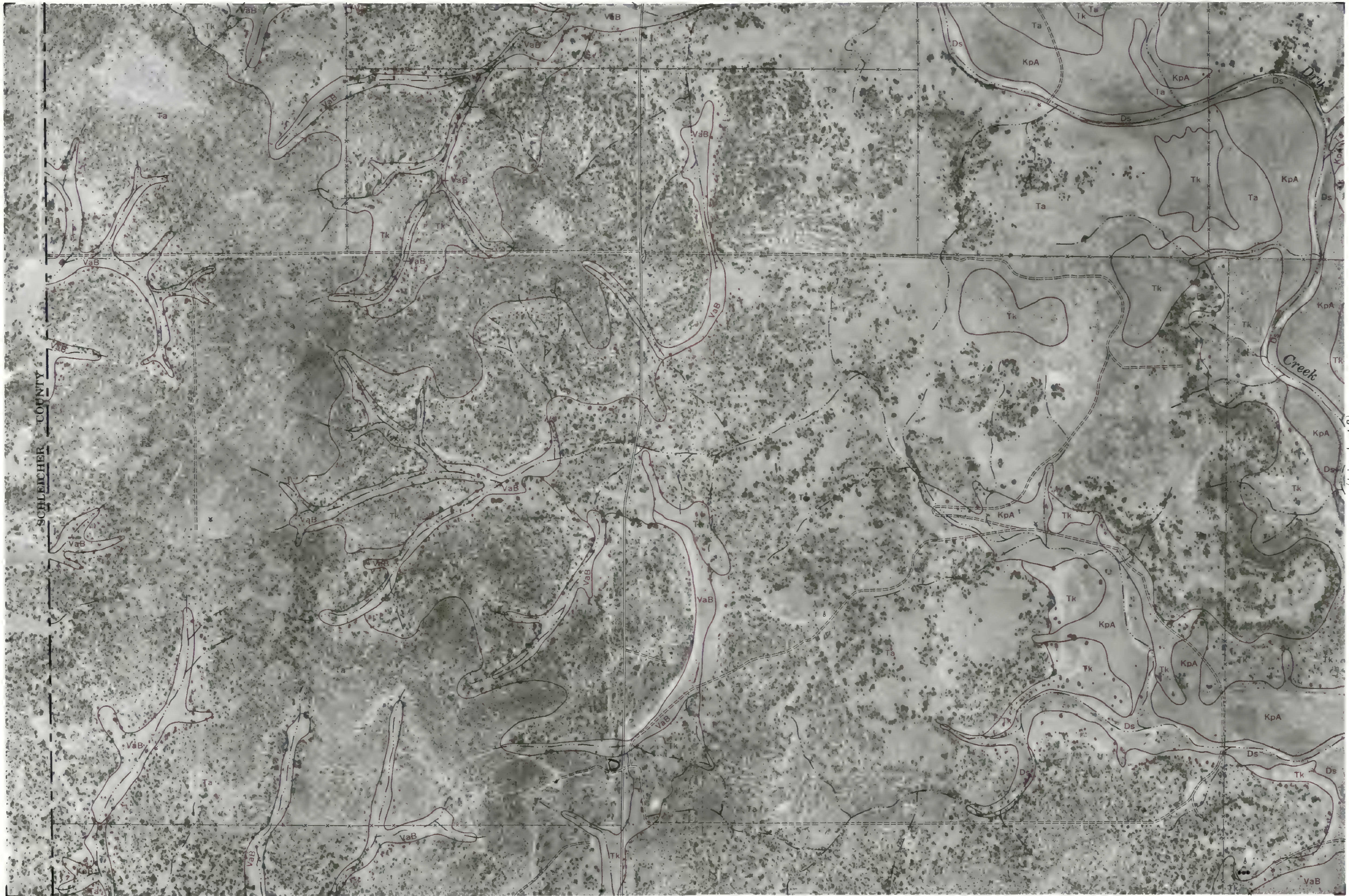
(Joins sheet 1)

7



(Joins sheet 8)

(Joins sheet 14)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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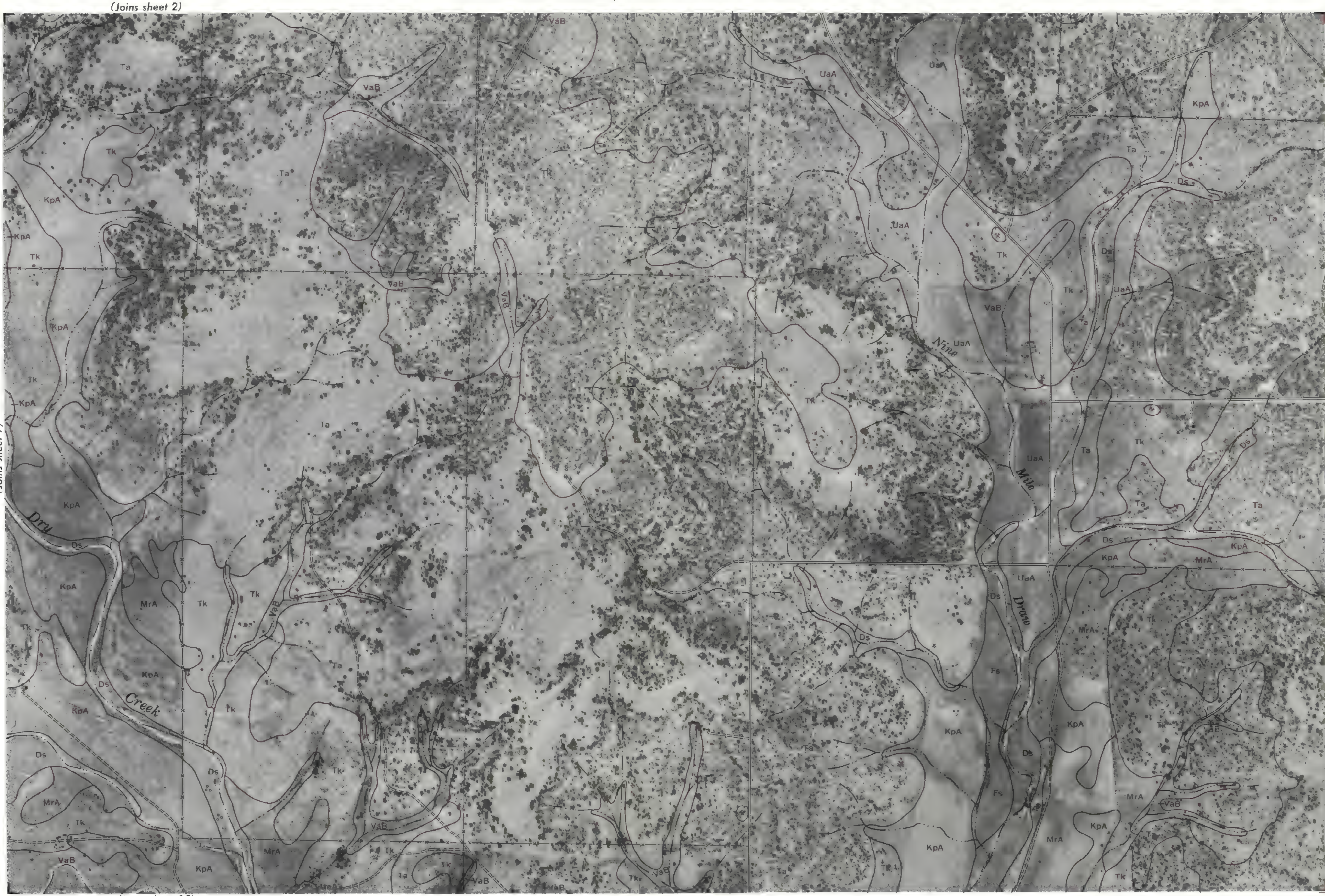
8

N

(Joins sheet 2)

(Joins sheet 7)



(Joins sheet 9)

(Joins sheet 15)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

9

(Joins sheet 3)

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 16)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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(10)

(Joins sheet 4)

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 17)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

11

(Joins sheet 5)

(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 18)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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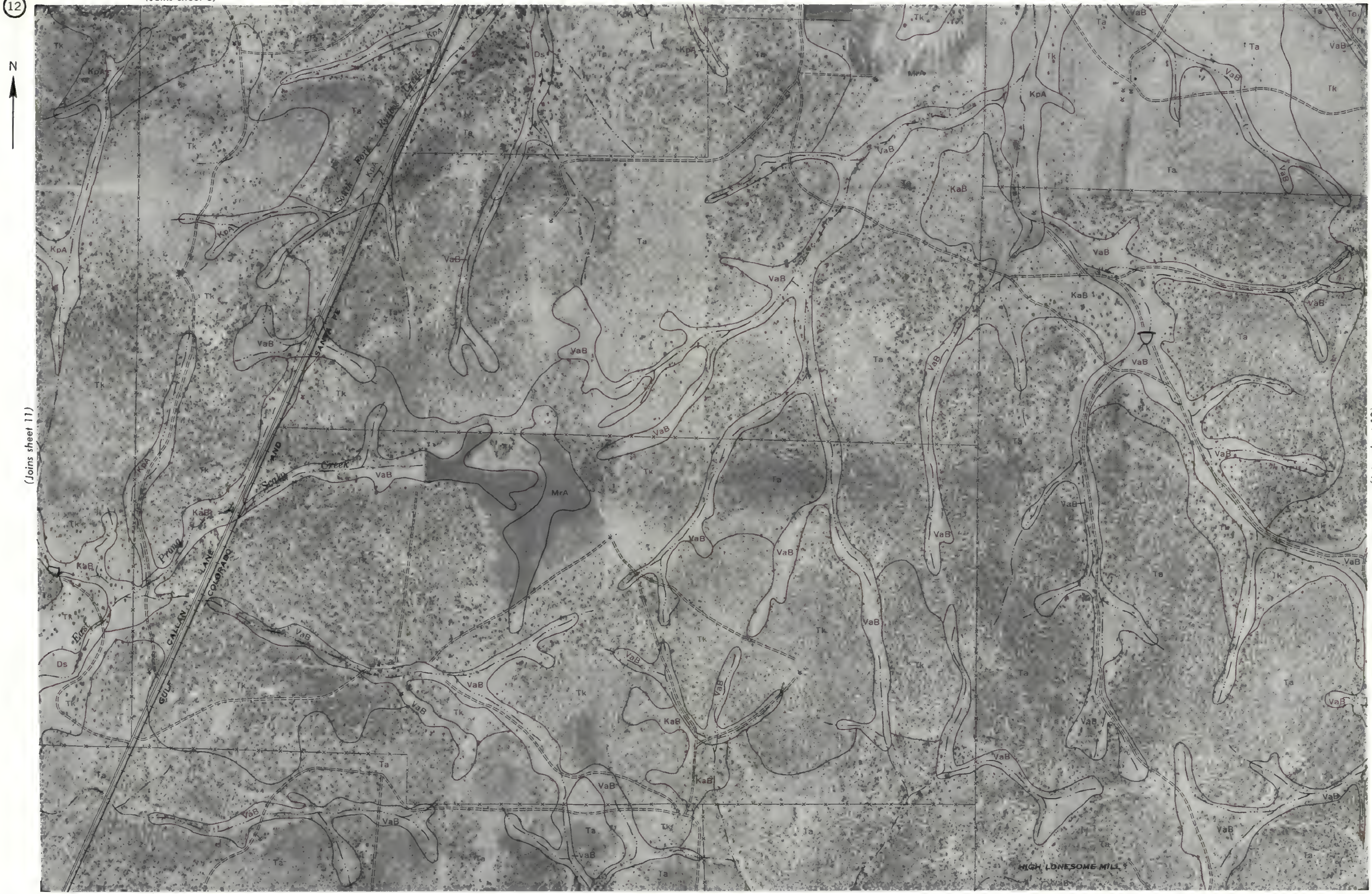
12

(Joins sheet 6)

(Joins sheet 11)



(Joins sheet 13)

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0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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(Joins sheet 12)

(Joins sheet 20)

(Joins sheet 6)

(Joins upper left)

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0 ½ 1 Mile

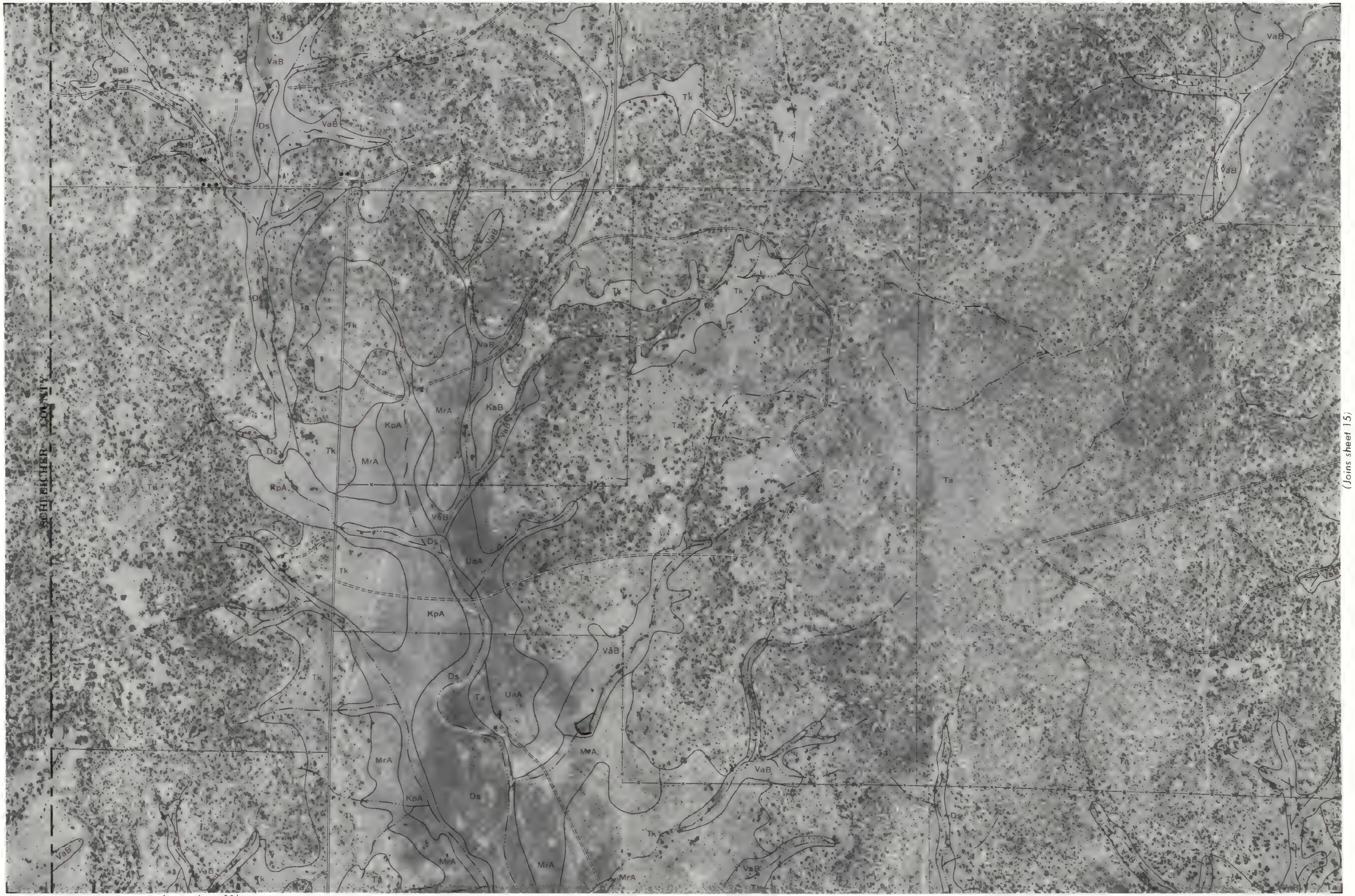
Scale 1: 20 000

0 5000 Feet

14

(Joins sheet 7)

N



(Joins sheet 21)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 8)

15

N

(Joins sheet 14)

(Joins sheet 16)

(Joins sheet 22)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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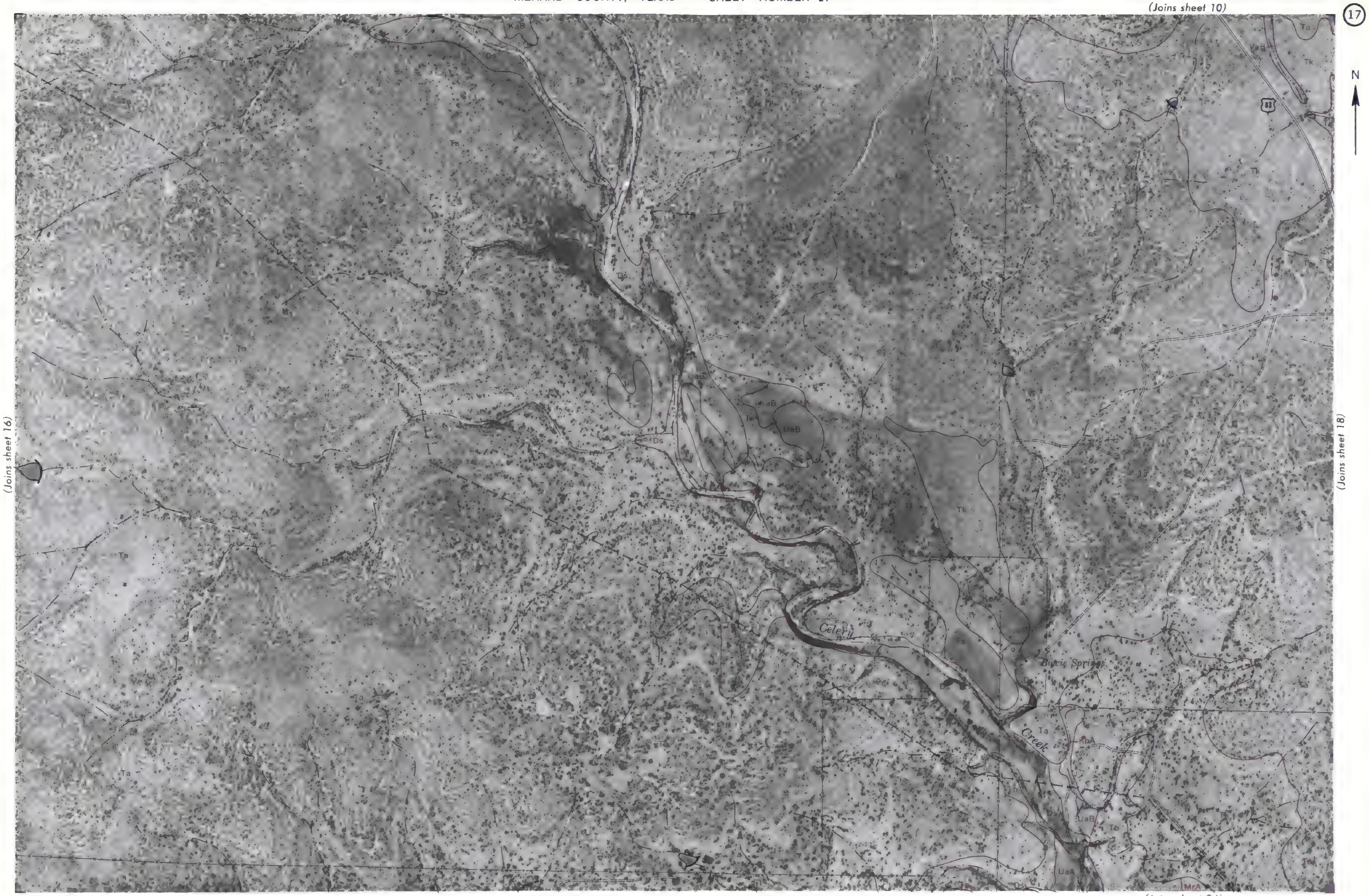
16
(Joins sheet 9)
N
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 23)
Ta
VaB
Tk
Ds
Fs
KaB
UaA
Silver Mine Creek
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet



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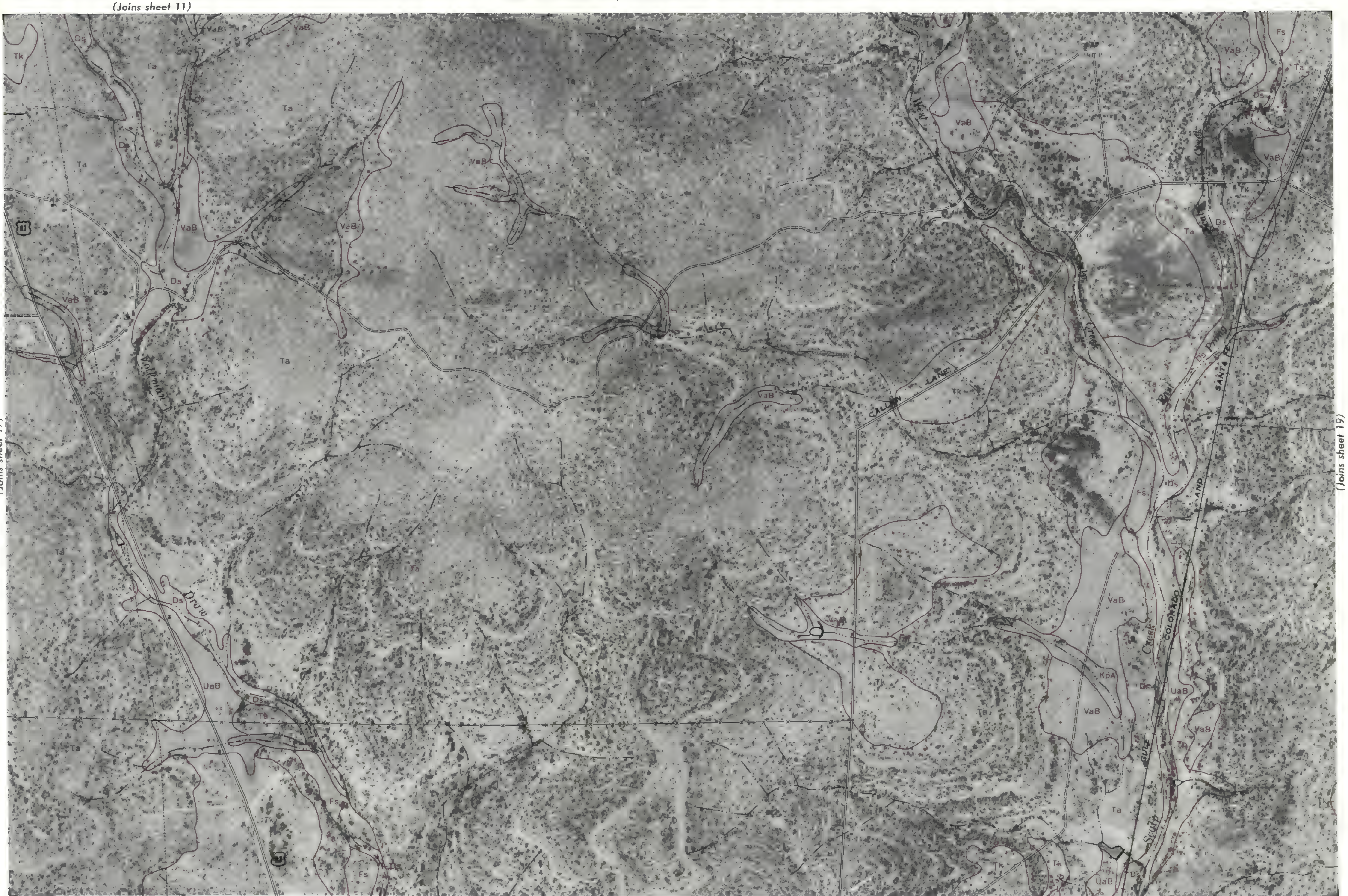
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

(18)

(Joins sheet 11)

(Joins sheet 17)



(Joins sheet 19)

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0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 12)

19

N

(Joins sheet 18)

(Joins sheet 20)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 26)

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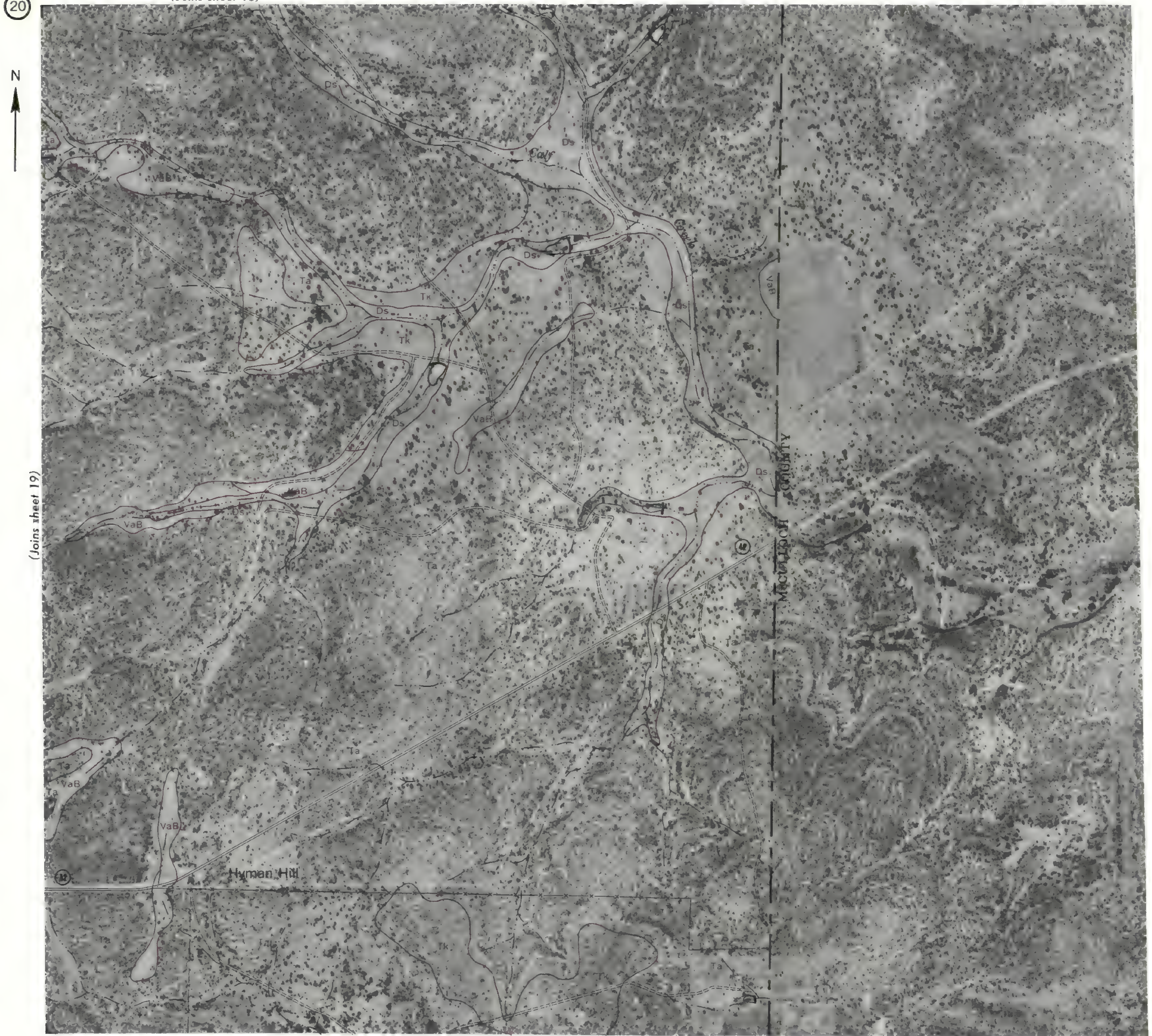
(20)

(Joins sheet 13)

(Joins sheet 19)



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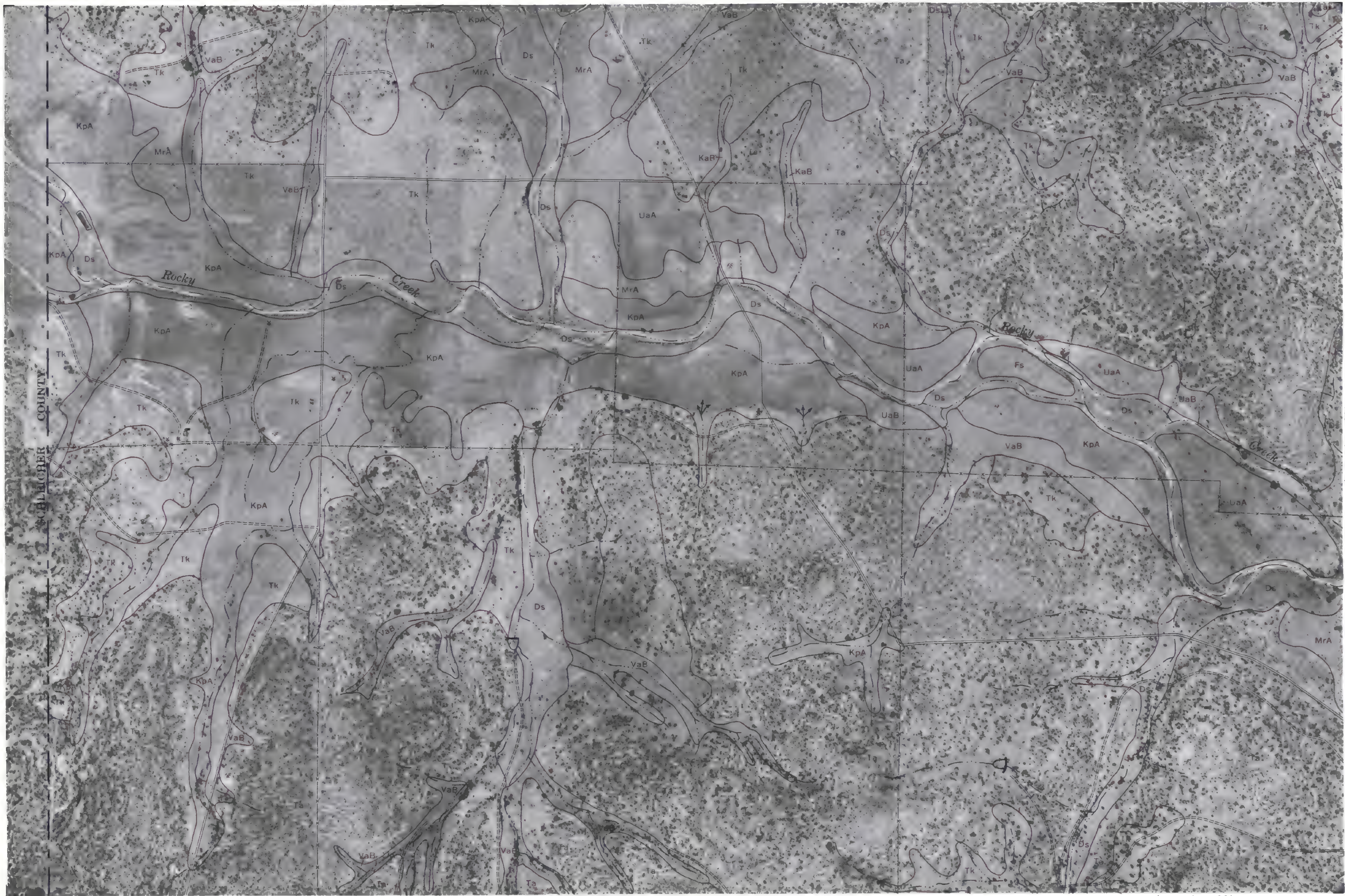
(Joins sheet 14)

21



(Joins sheet 22)

(Joins sheet 29)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

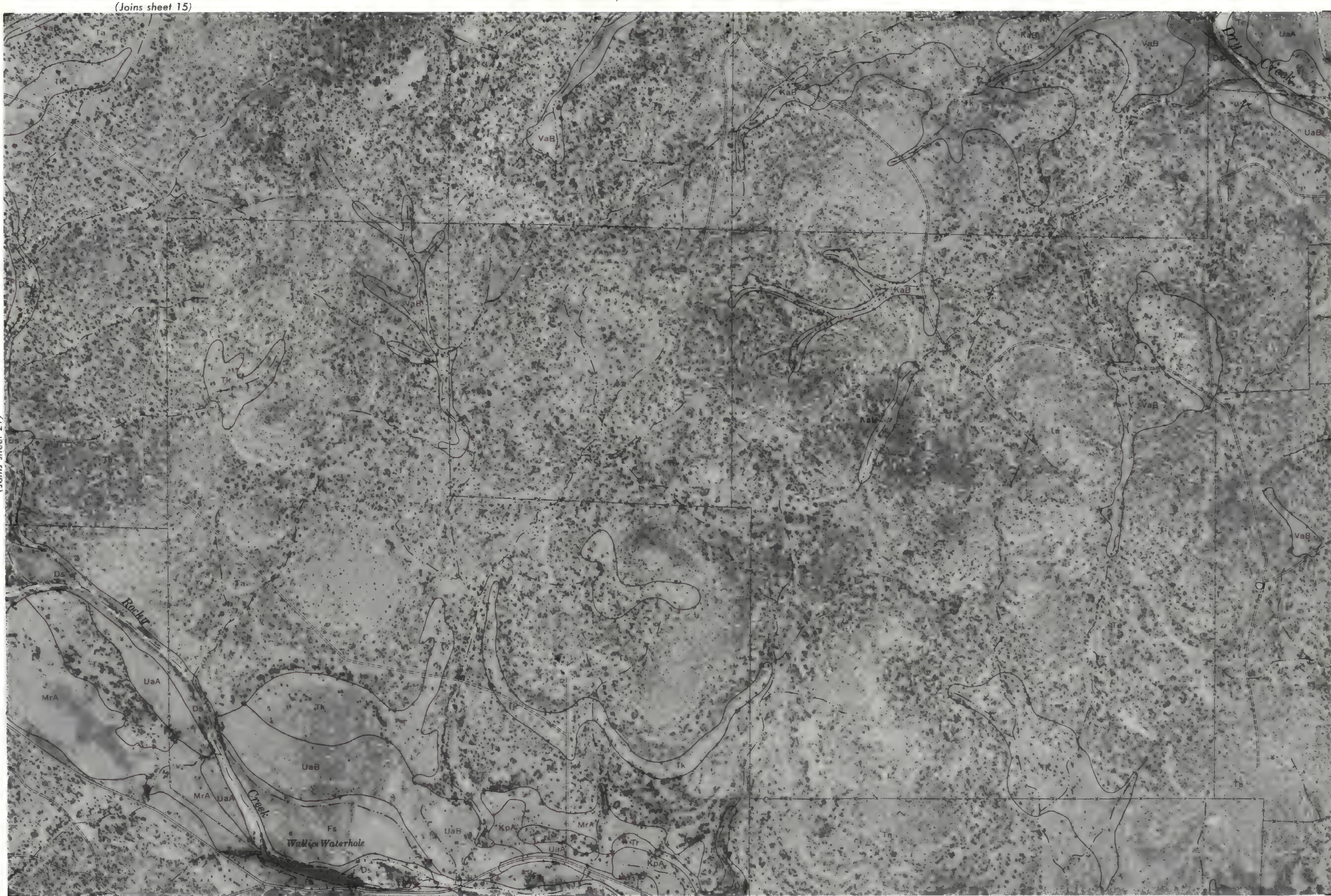
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

22

(Joins sheet 15)

N

(Joins sheet 21)



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(Joins sheet 30)

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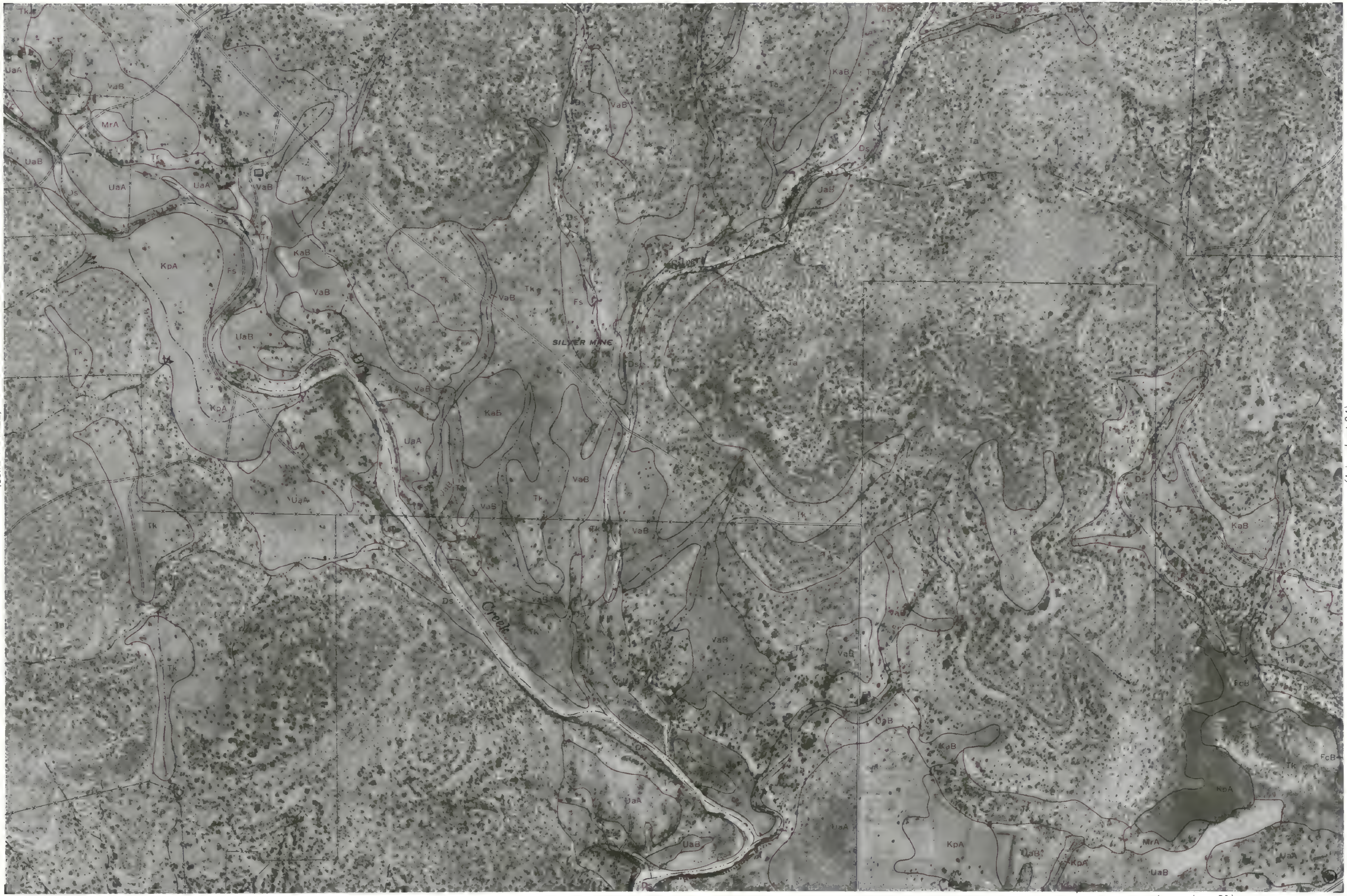
(Joins sheet 22)



(Joins sheet 24)

(Joins sheet 31)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

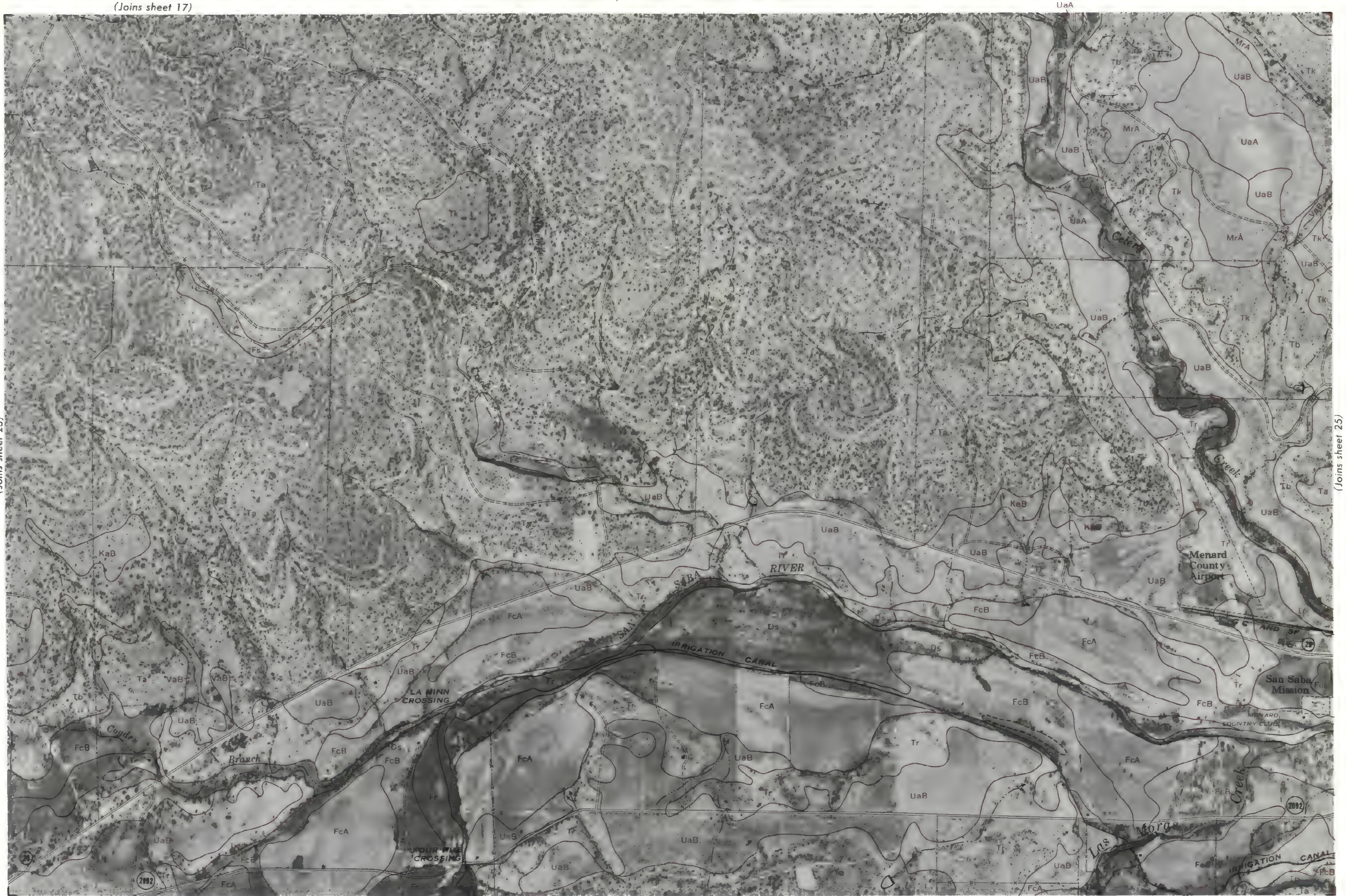
24

(Joins sheet 17)

(Joins sheet 23)

(Joins sheet 25)

N



(Joins sheet 32)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 18)

25

N

(Joins sheet 24)

(Joins sheet 26)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 33)

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26

(Joins sheet 19)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 34)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

27

(Joins sheet 20)

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 35)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

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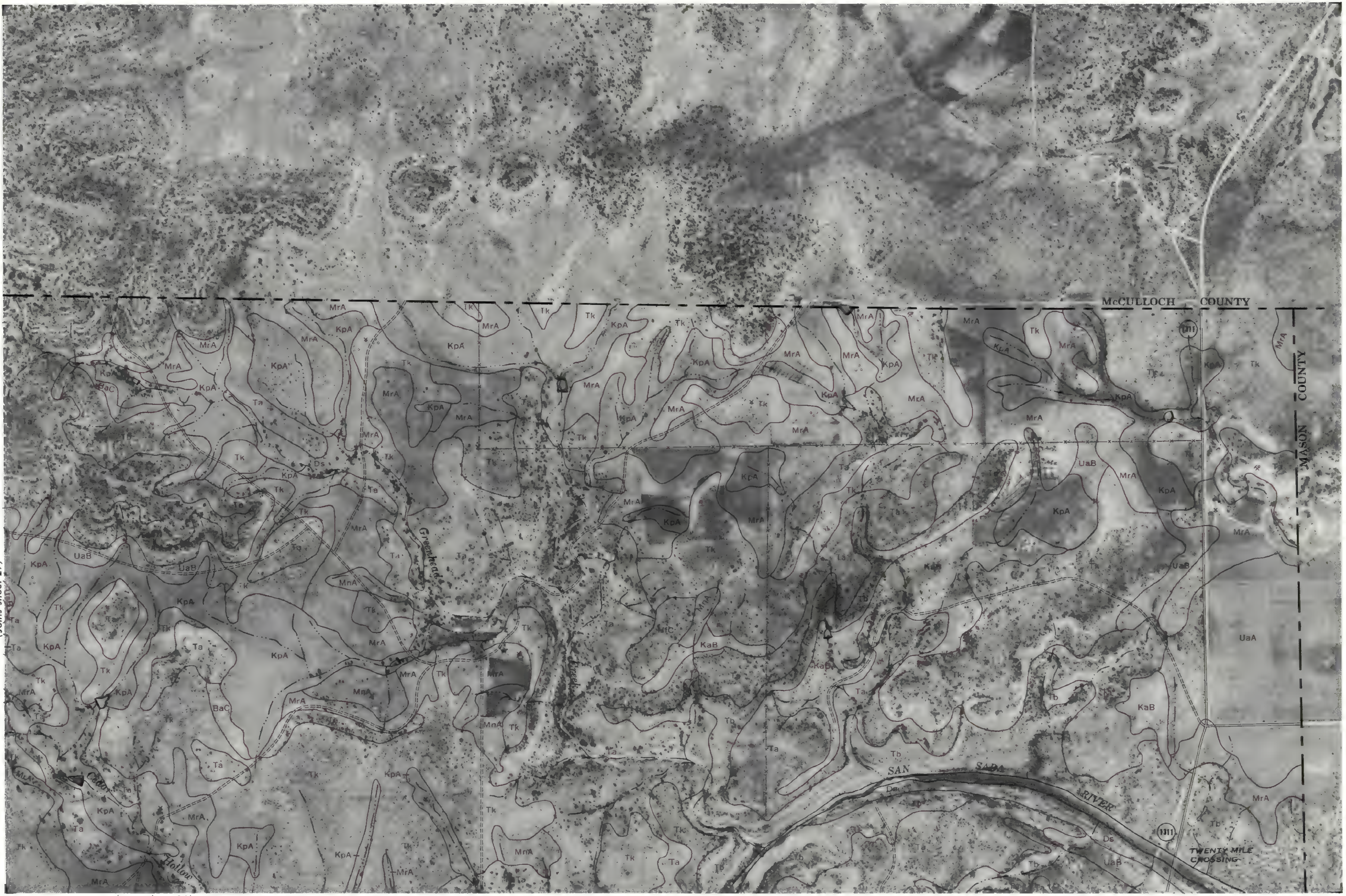
28

N



(Joins sheet 27)

(Joins sheet 36)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 21)

29

(Joins sheet 30)

(Joins sheet 37)

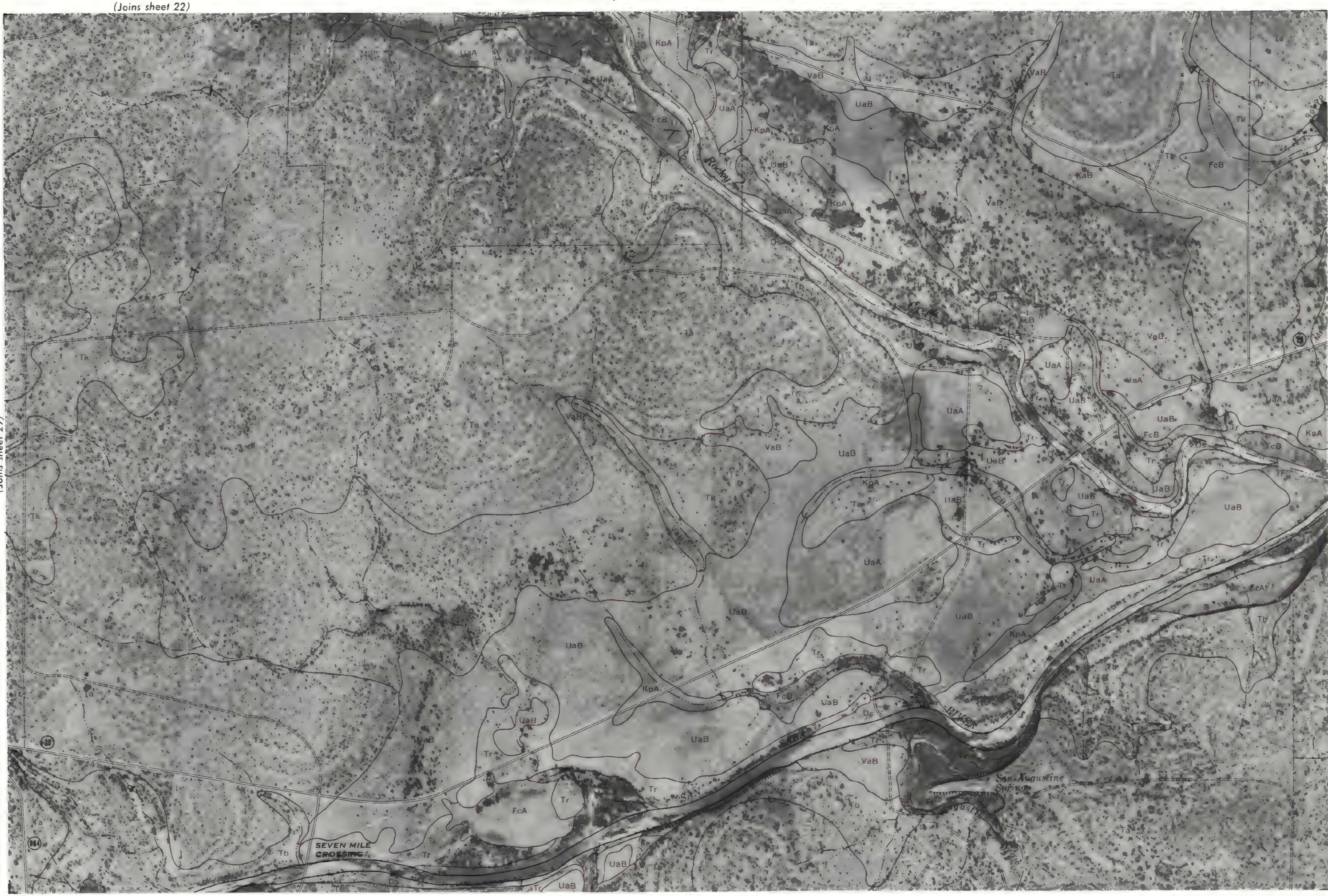
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

30

(Joins sheet 22)

(Joins sheet 29)



(Joins sheet 31)

(Joins sheet 38)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 23)

31

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 39)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

32

(Joins sheet 24)

N

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 40)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 25)

33

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 41)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

34

(Joins sheet 26)

N

(Joins sheet 33)

(Joins sheet 35)

(Joins sheet 42)

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

35

(Joins sheet 27)

(Joins sheet 34)

(Joins sheet 36)

(Joins sheet 43)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

36

(Joins sheet 28)

N

(Joins sheet 35)

(Joins sheet 44)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 29)

37

N

(Joins sheet 38)

(Joins sheet 45)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

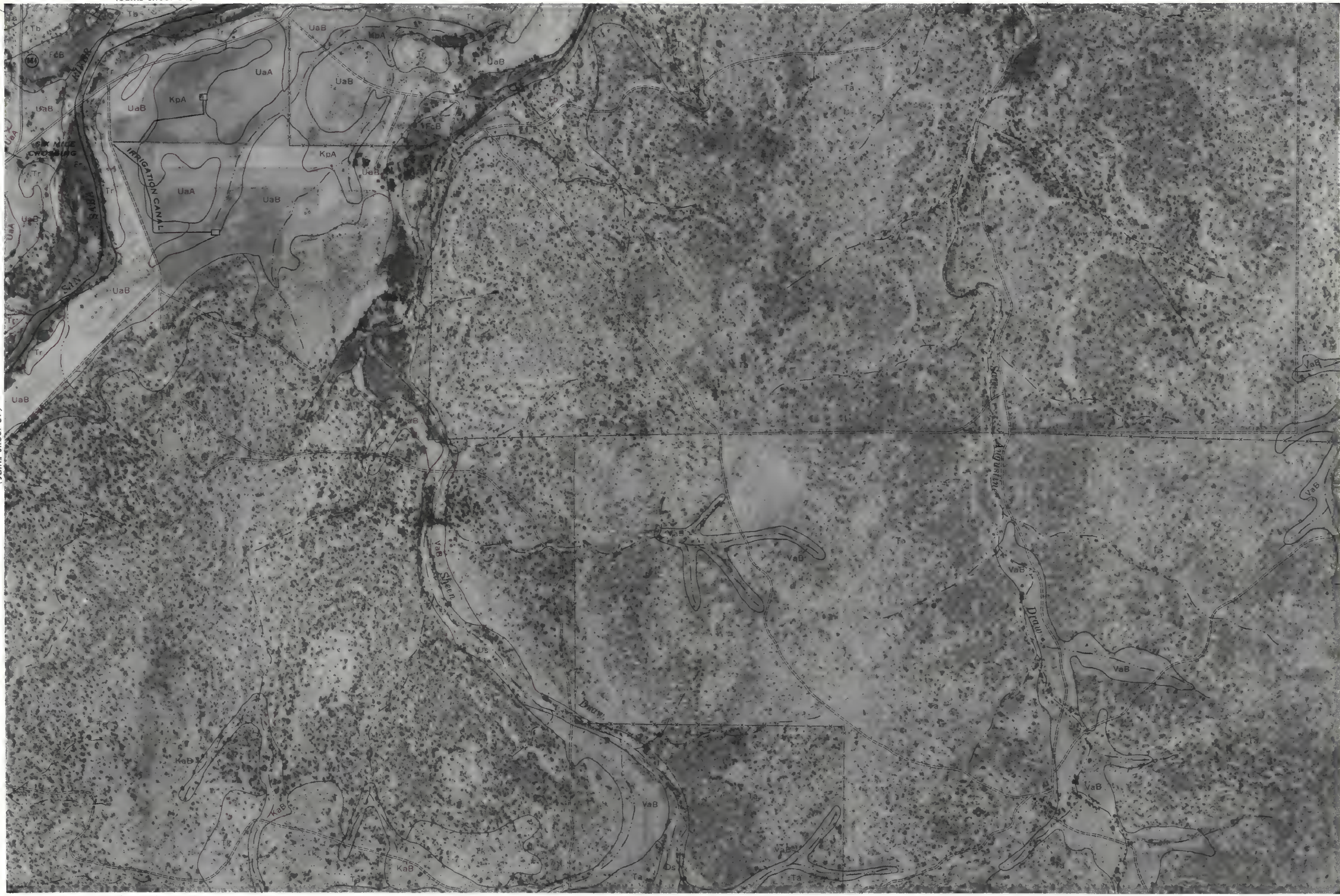
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

38

(Joins sheet 30)

N

(Joins sheet 37)



(Joins sheet 39)

(Joins sheet 46)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(39)

(Joins sheet 31)

N

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

(Joins sheet 38)

(Joins sheet 40)

(Joins sheet 47)

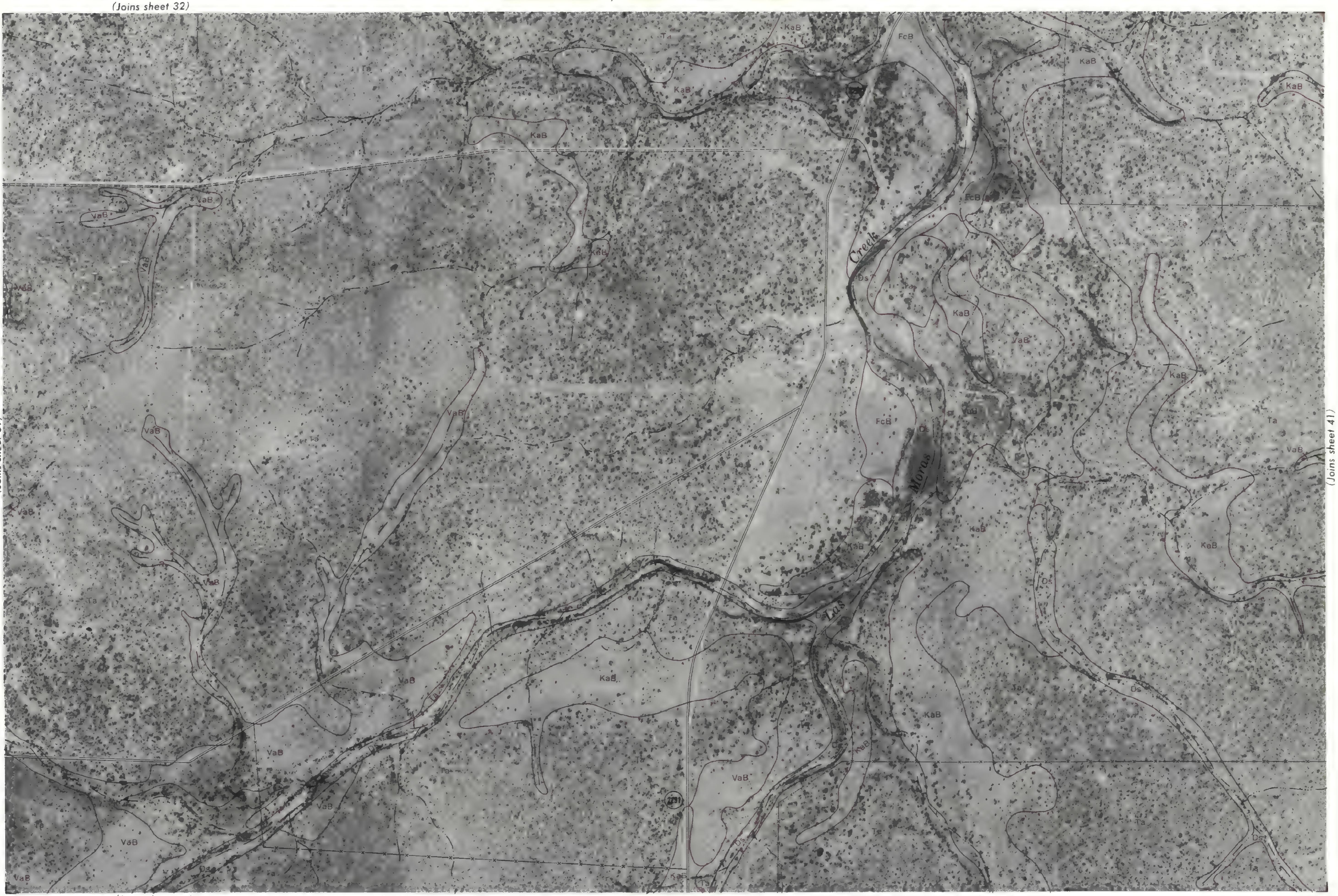
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

40

N

(Joins sheet 32)

(Joins sheet 39)



(Joins sheet 41)

(Joins sheet 48)

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

(Joins sheet 33)

41

N

(Joins sheet 40)

(Joins sheet 42)

(Joins sheet 49)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

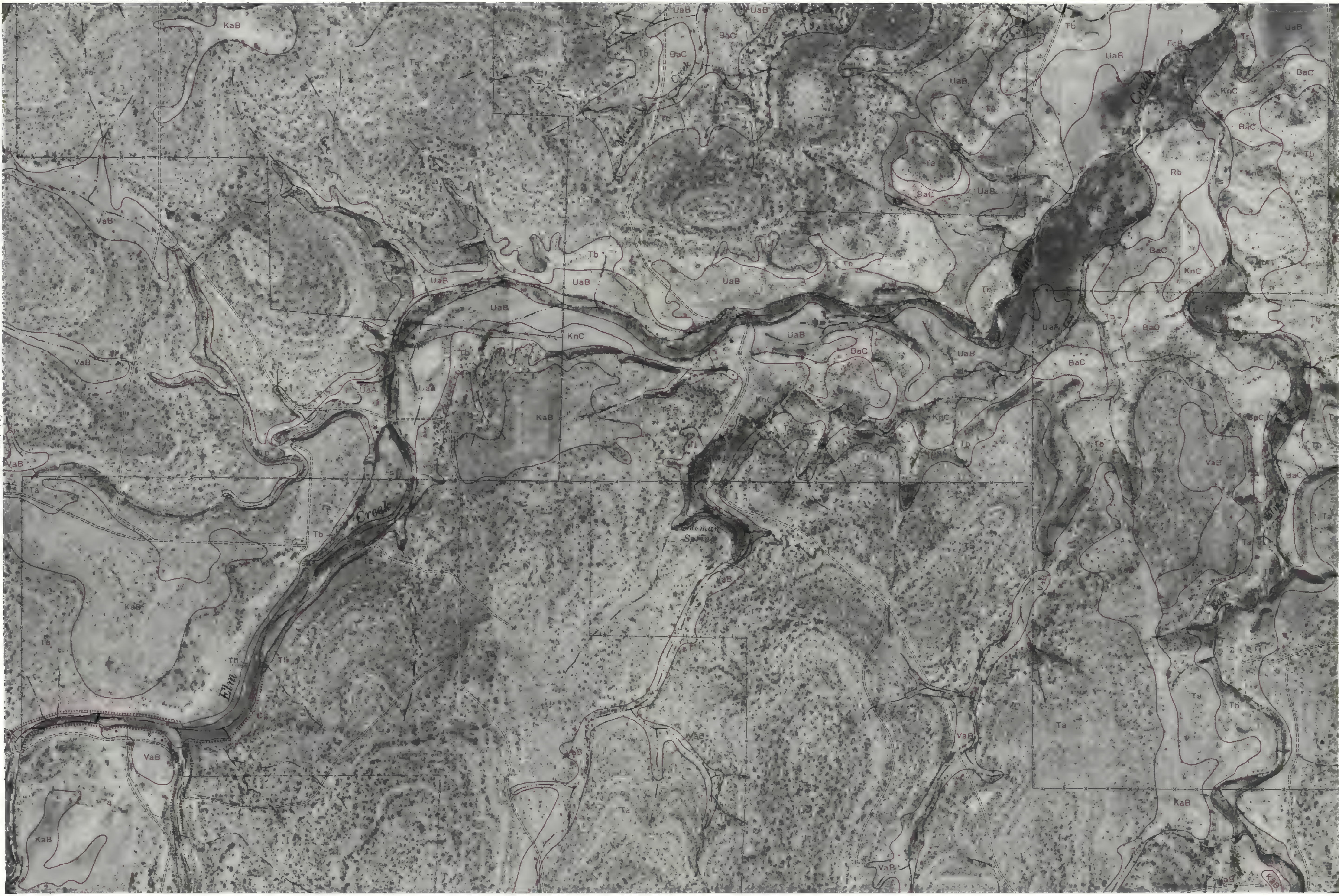
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

42

(Joins sheet 34)

N

(Joins sheet 41)



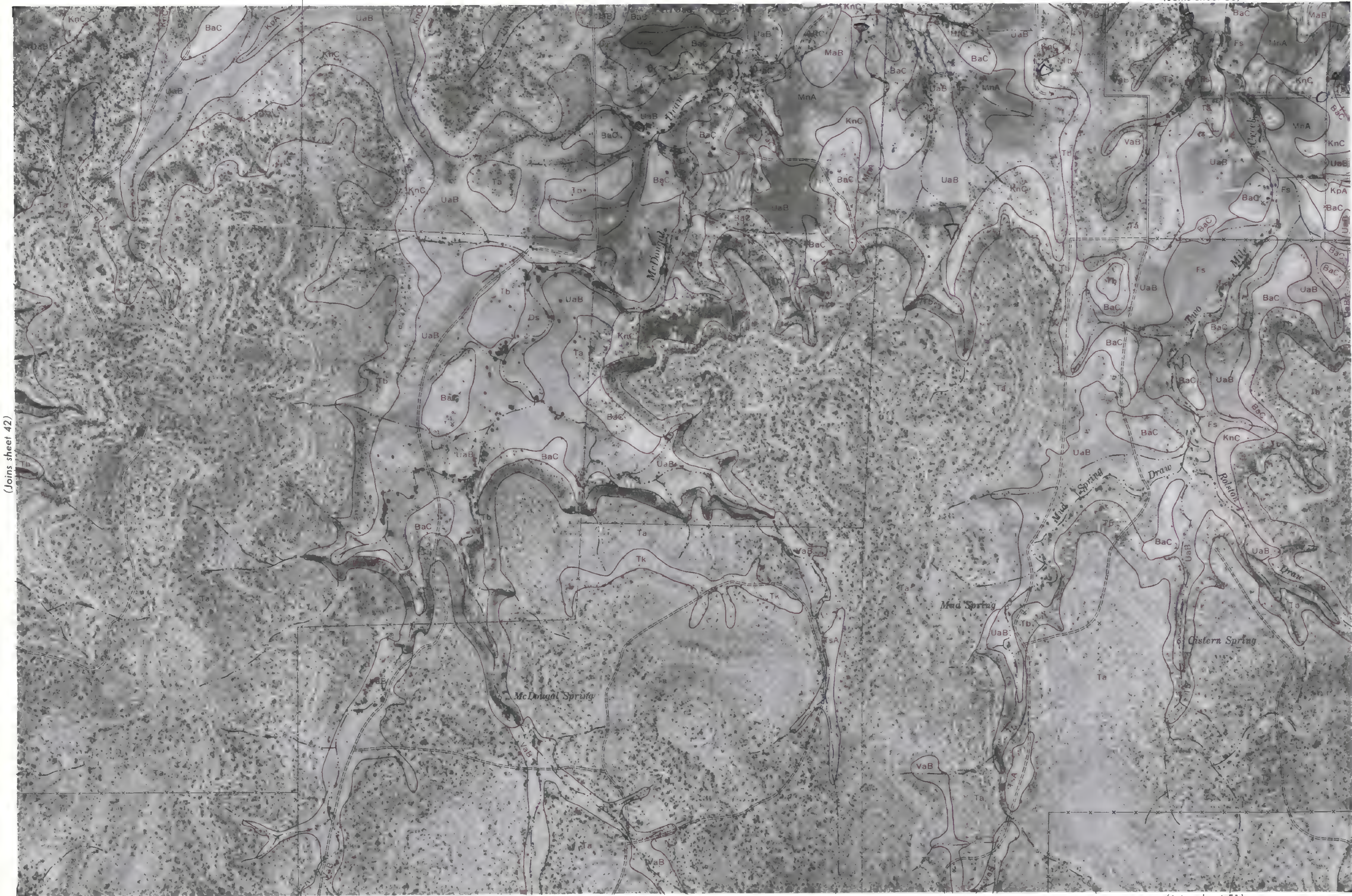
(Joins sheet 43)

(Joins sheet 50)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 35)

(Joins sheet 42)



(Joins sheet 44)

(Joins sheet 51)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

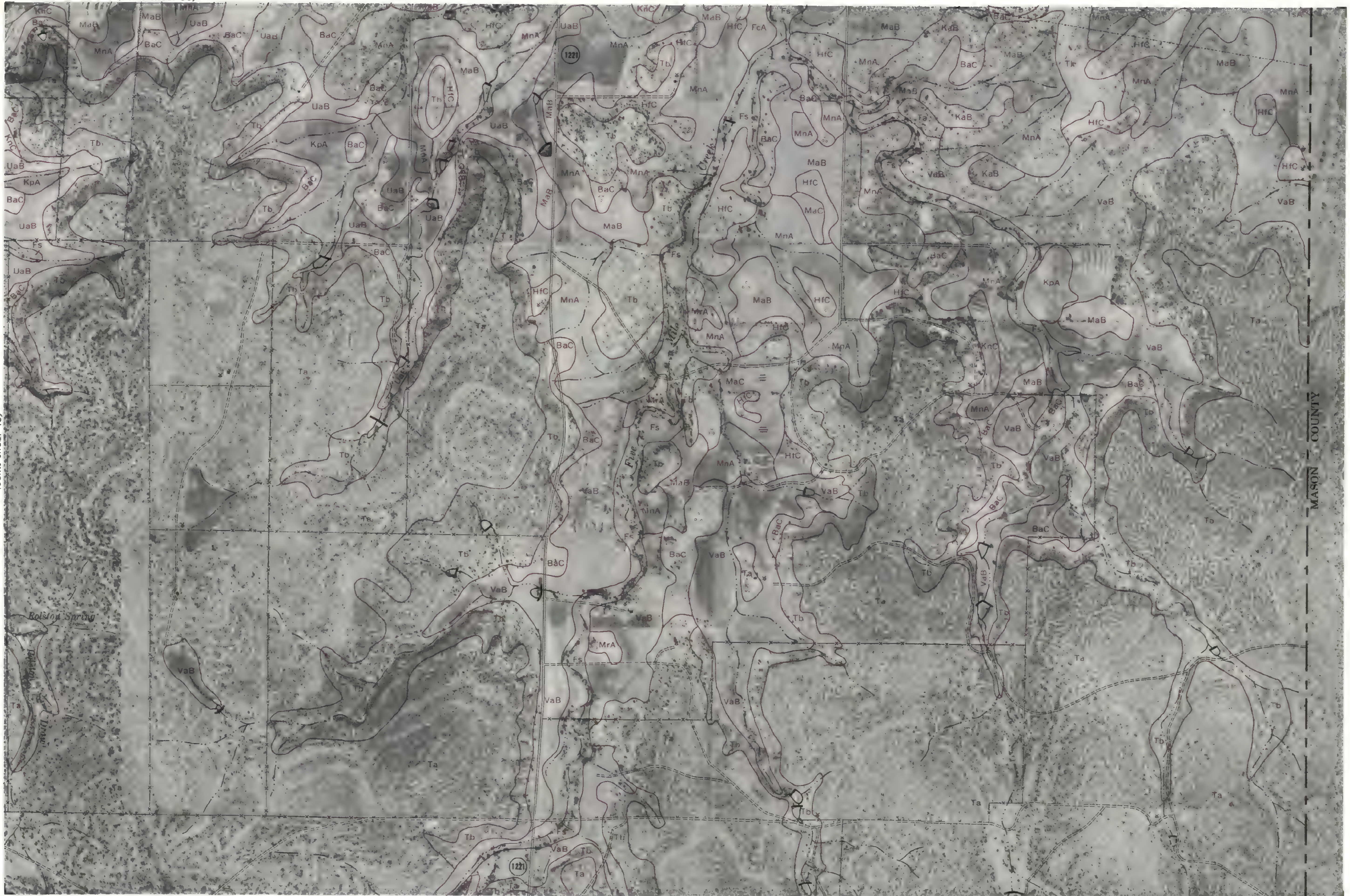
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

44

(Joins sheet 36)

N

(Joins sheet 43)



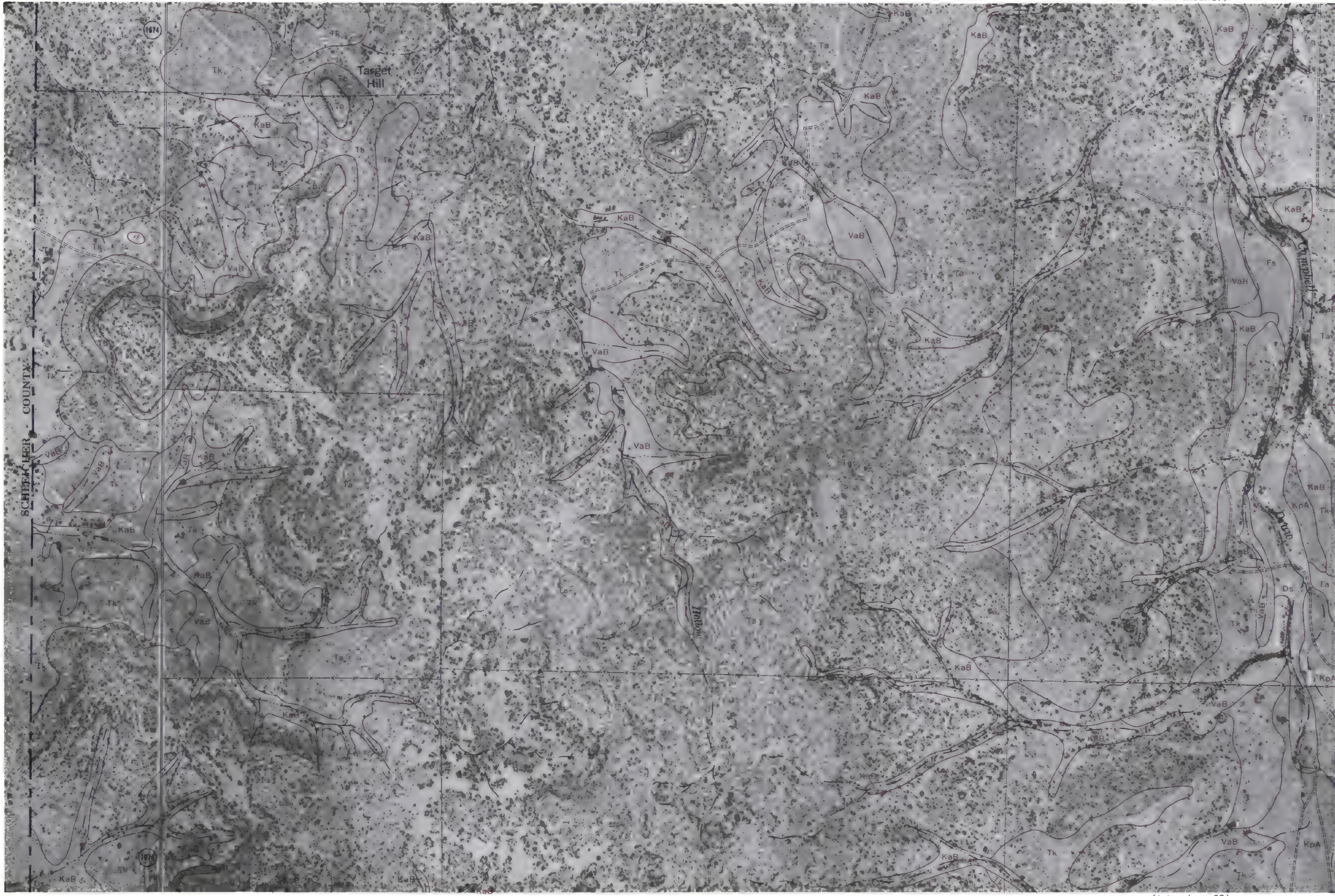
(Joins sheet 52)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

45

(Joins sheet 37)

N

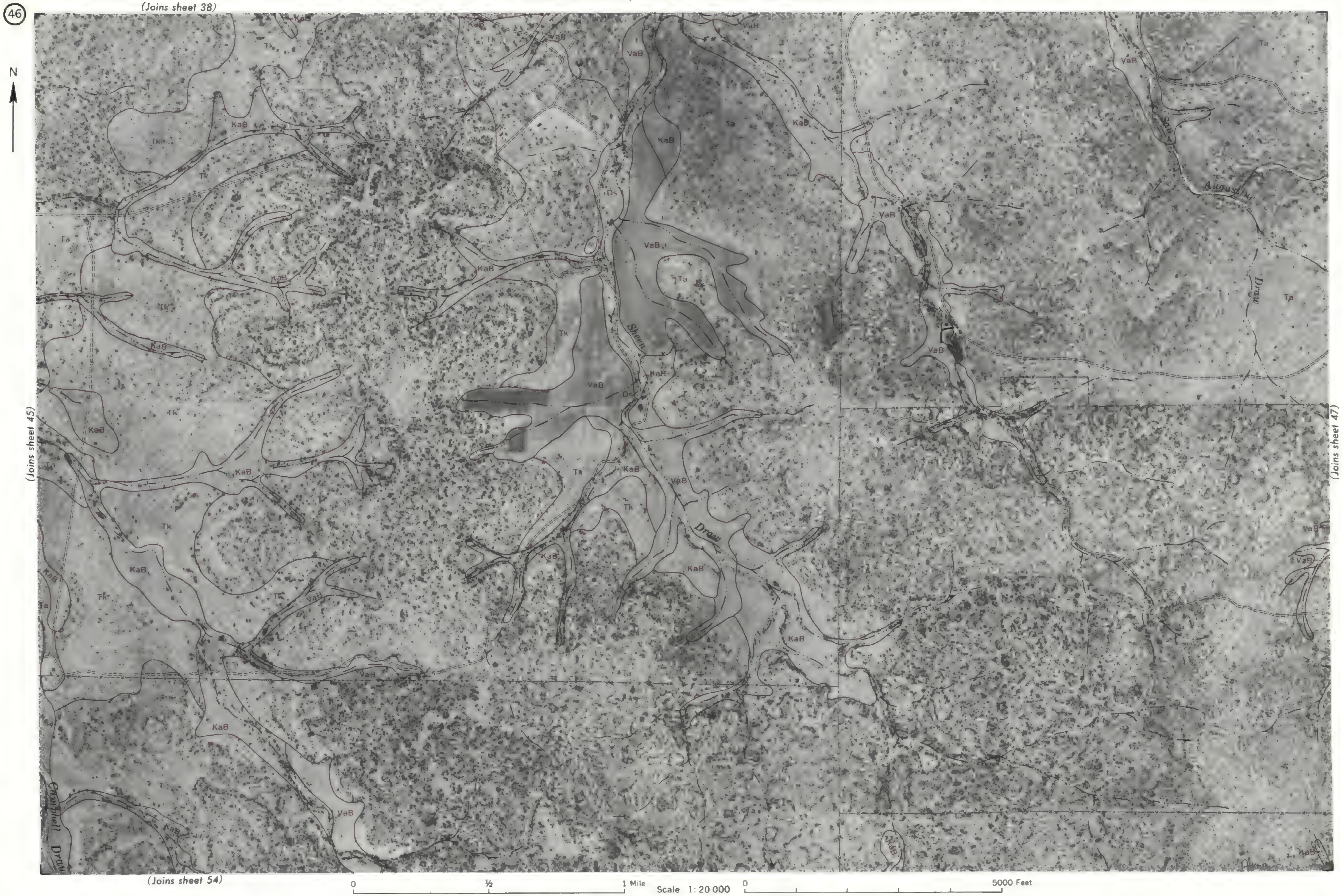


(Joins sheet 46)

(Joins sheet 53)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.


46
N
(Joins sheet 38)
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 54)
Ta
Tk
KaB
VaB
Ds
Sheen
Draw
San
Augustine
Draw
Campbell
Draw
0
½
1 Mile
Scale 1: 20 000
0
5000 Feet

47

(Joins sheet 39)

(Joins sheet 46)

(Joins sheet 48)

(Joins sheet 55)

0 ½ 1 Mile

Scale 1: 20 000

0 5000 Feet

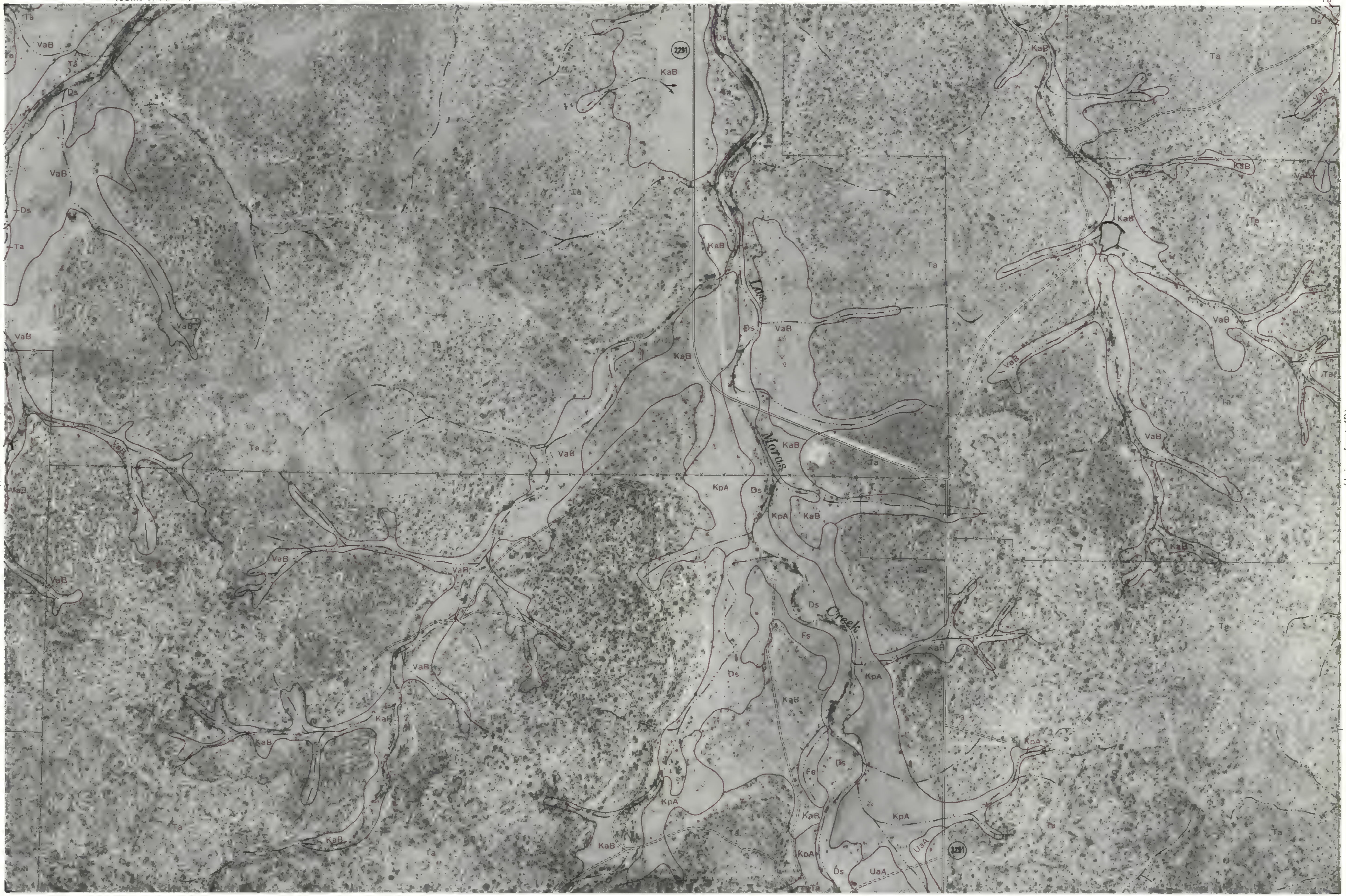
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

48

(Joins sheet 40)

N

(Joins sheet 47)



(Joins sheet 49)

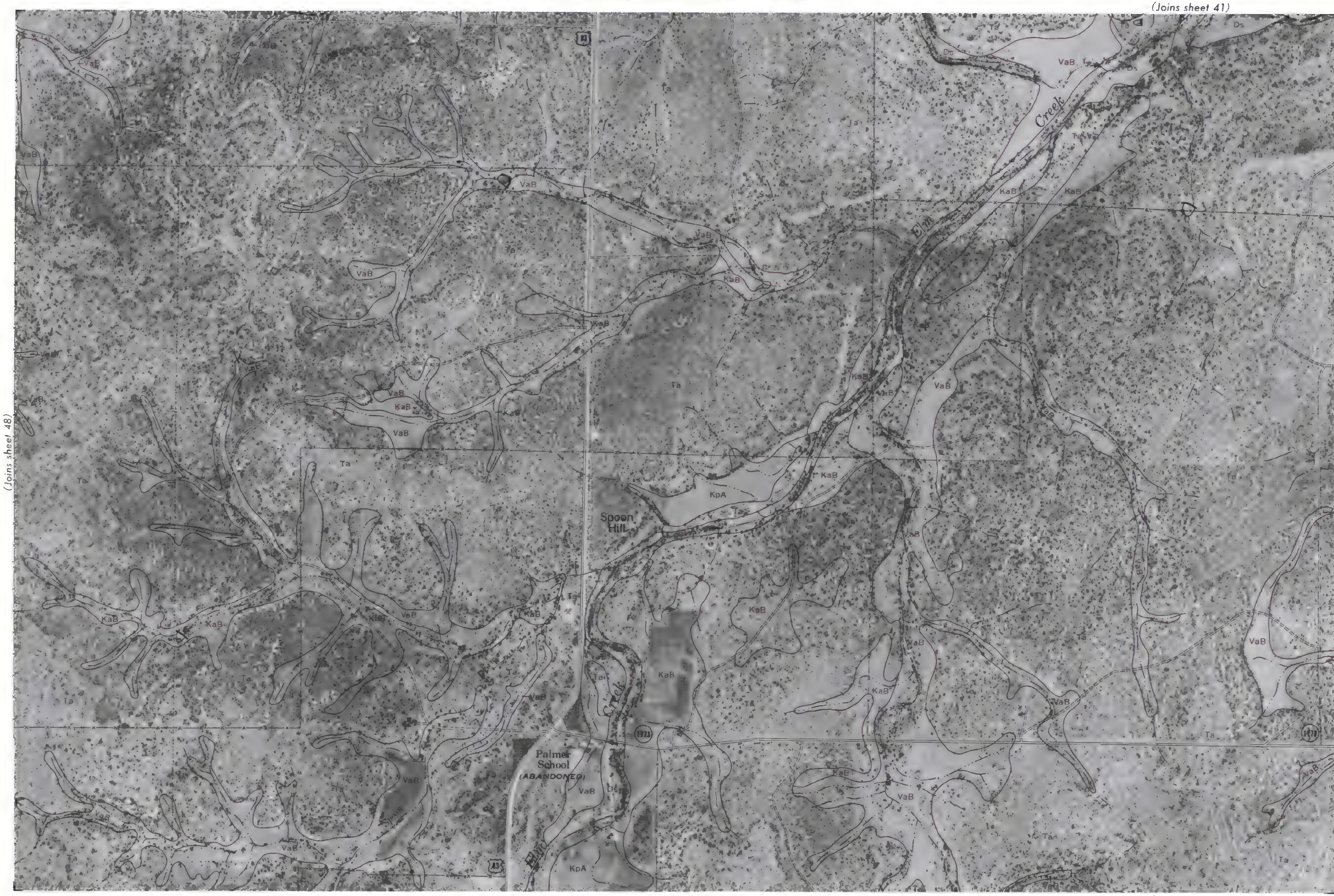
(Joins sheet 56)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 41)

49

(Joins sheet 48)



(Joins sheet 50)

(Joins sheet 57)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

50

(Joins sheet 42)

(Joins sheet 58)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 43)

51

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 59)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

52

(Joins sheet 44)

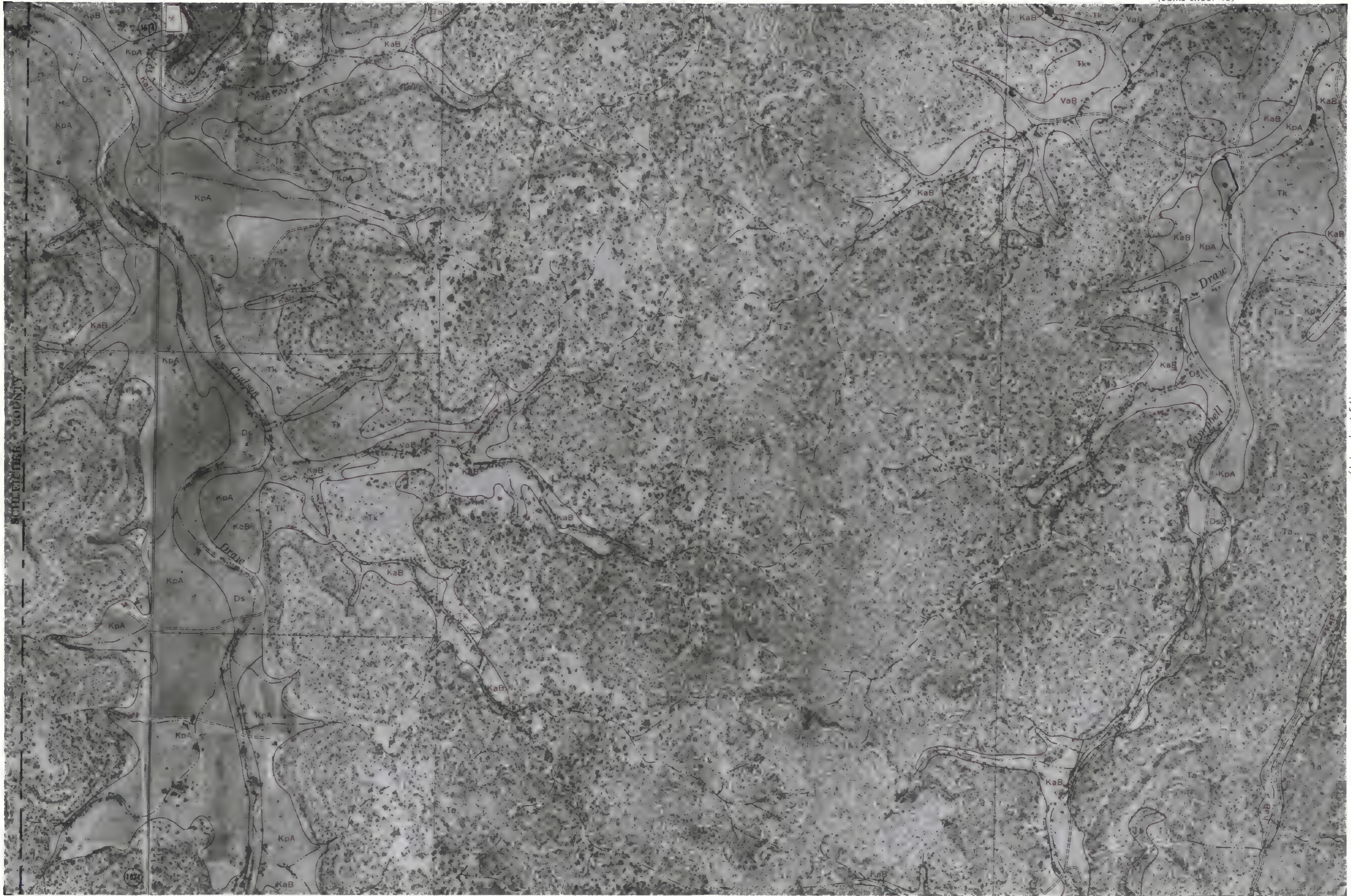
(Joins sheet 51)

(Joins sheet 60)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 45)

53



(Joins sheet 54)

(Joins inset, sheet 61)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

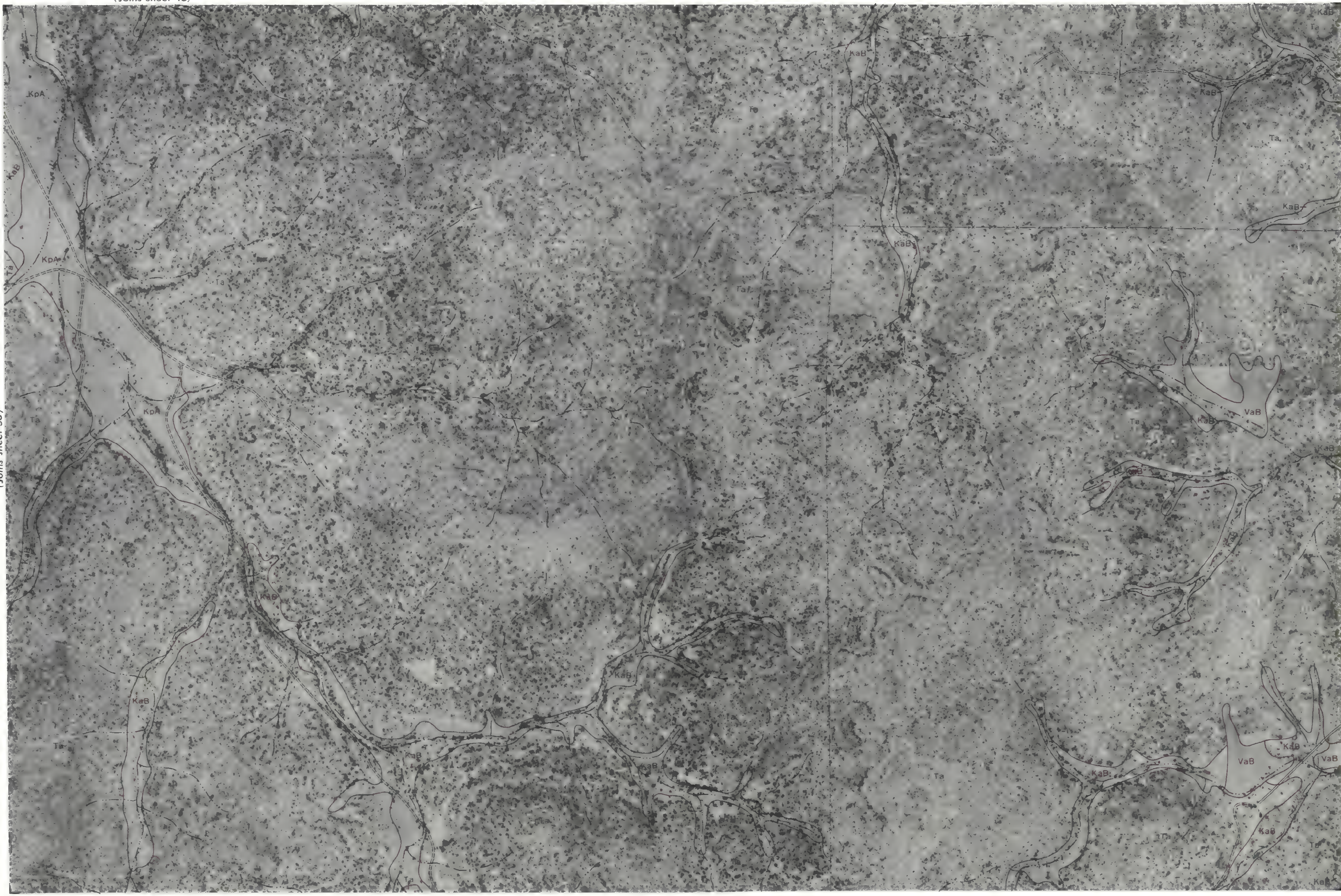
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

54

(Joins sheet 46)

N

(Joins sheet 53)



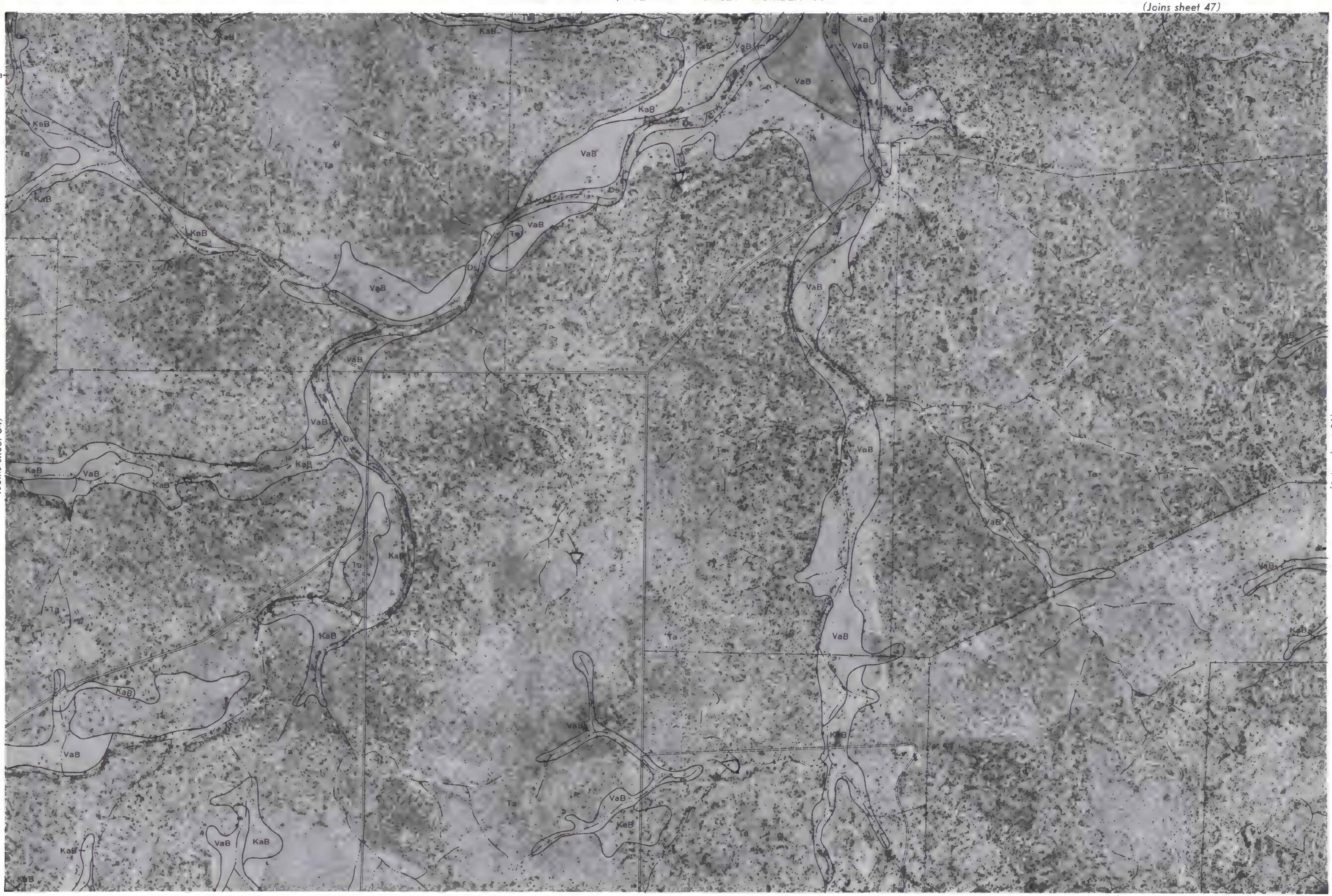
(Joins sheet 55)

(Joins sheet 61)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 47)

(Joins sheet 54)



(Joins sheet 56)

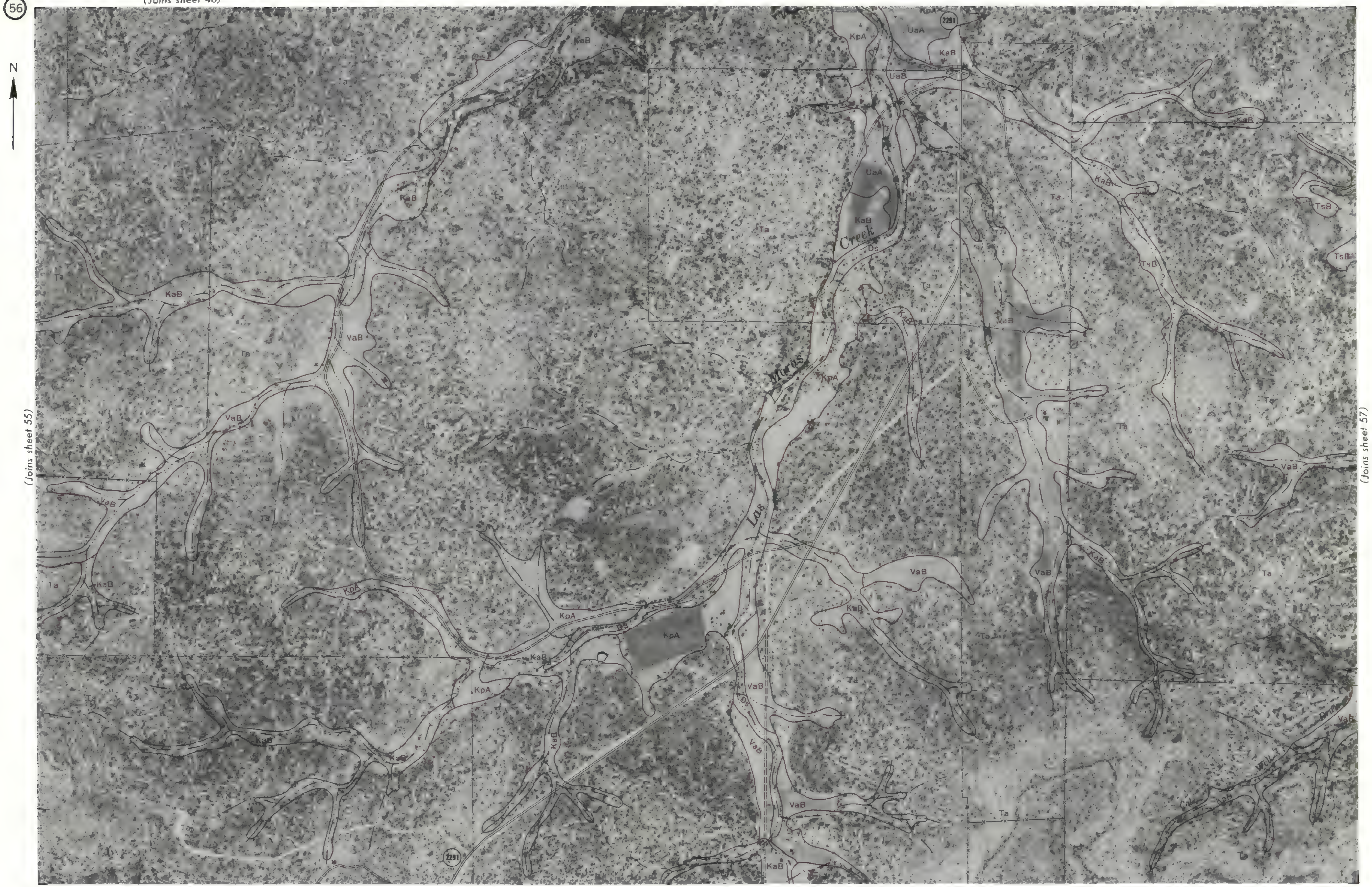
(Joins inset, sheet 62)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

56

(Joins sheet 48)



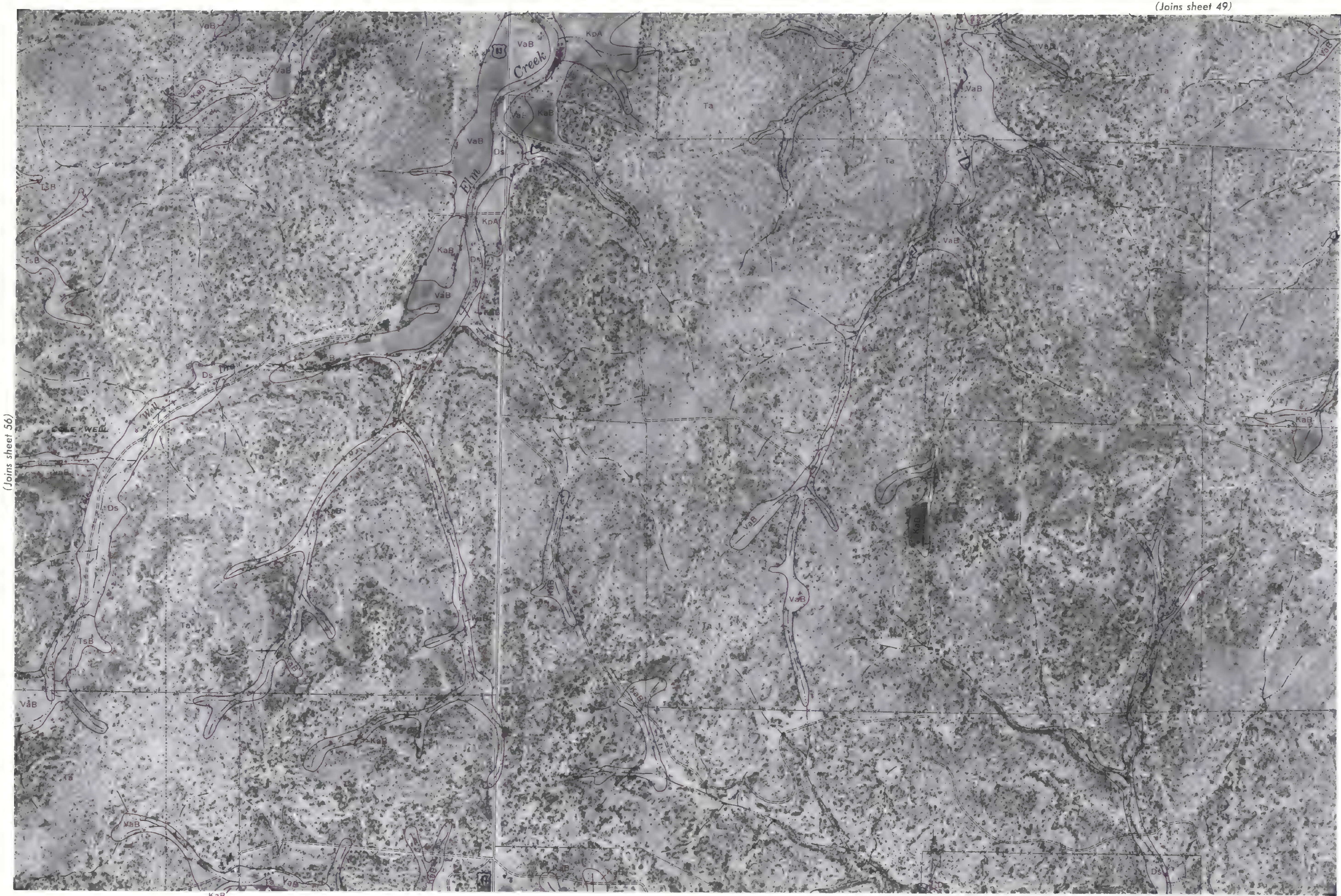
(Joins sheet 62)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

MENARD COUNTY, TEXAS — SHEET NUMBER 57

(Joins sheet 49)

57



(Joins sheet 56)

(Joins sheet 58)

(Joins inset, sheet 63)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

58

(Joins sheet 50)

N

(Joins sheet 57)

(Joins sheet 59)

(Joins sheet 63)

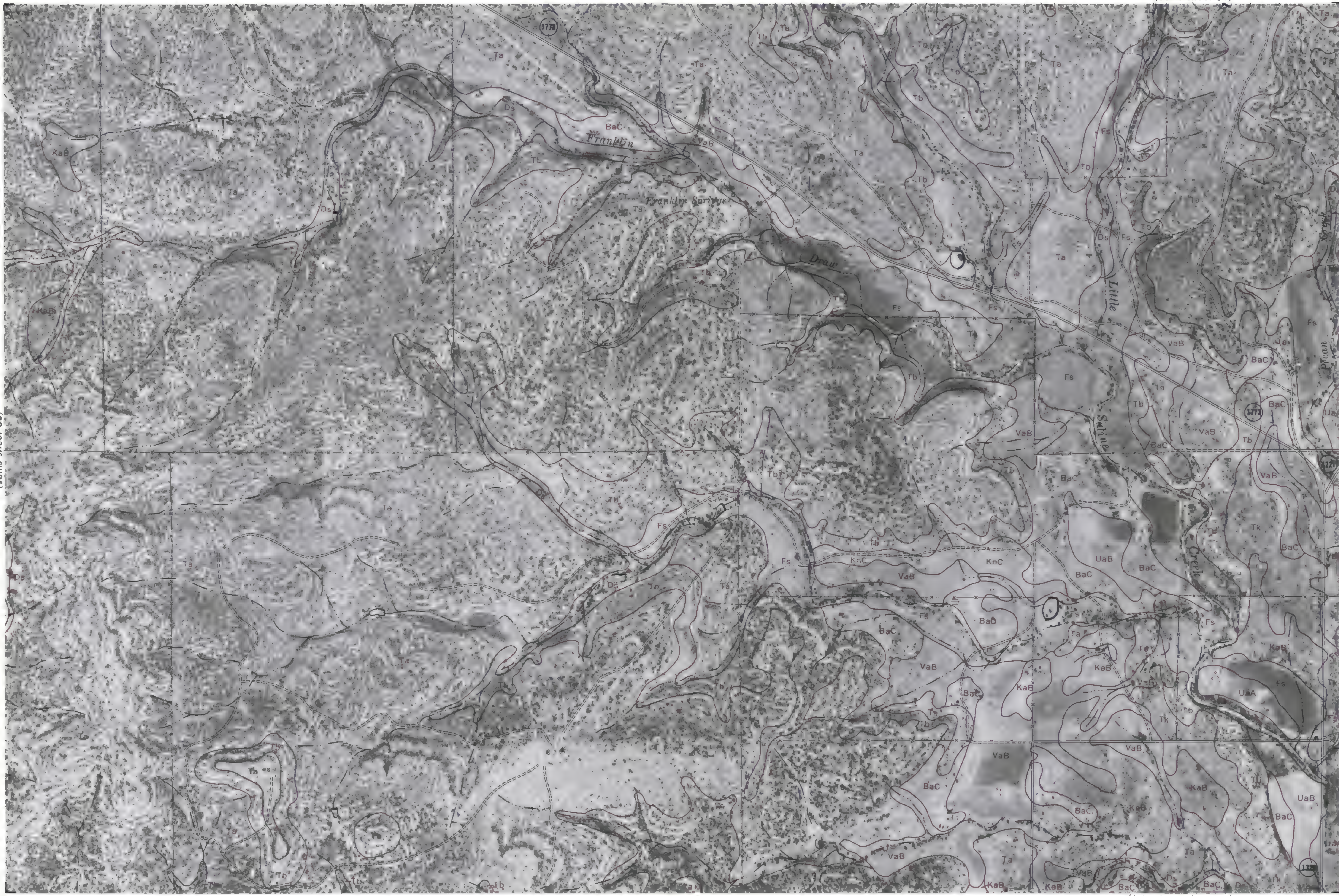
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 51)

59

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station

(Joins sheet 58)



(Joins sheet 60)

(Joins inset, sheet 64)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

MENARD COUNTY, TEXAS — SHEET NUMBER 60

(Joins sheet 52)

N

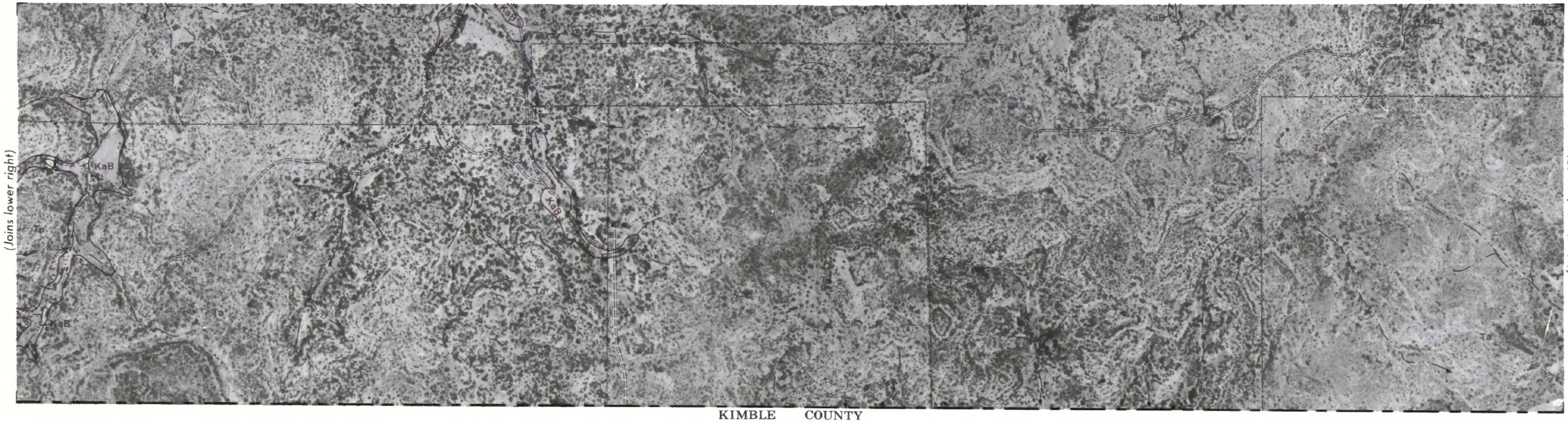
(Joins sheet 59)

(Joins sheet 64)

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 54)

(Joins lower right)



(Joins inset, sheet 62)

KIMBLE COUNTY

(Joins sheet 53)

SCHLEICHER COUNTY

(Joins upper left)

KIMBLE COUNTY

0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

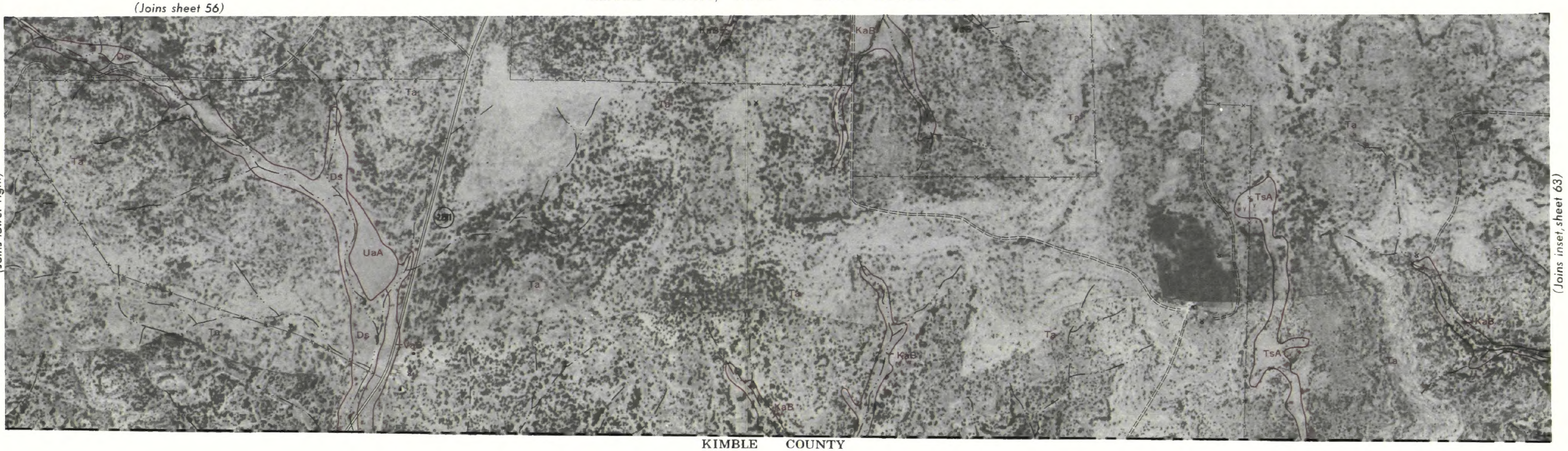
This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

62

N

(Joins sheet 56)

(Joins lower right)



(Joins inset, sheet 63)

KIMBLE COUNTY

(Joins sheet 55)

(Joins sheet 61)

(Joins upper left)

KIMBLE COUNTY

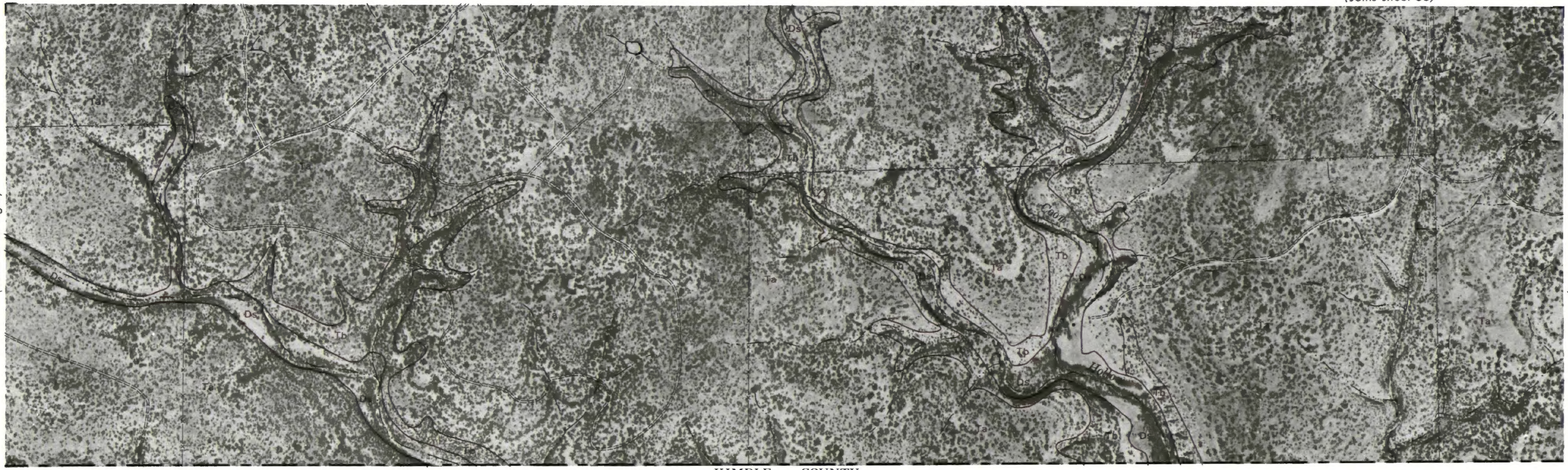
0 ½ 1 Mile Scale 1: 20 000 0 5000 Feet

(Joins sheet 58)

63

N

(Joins lower right)

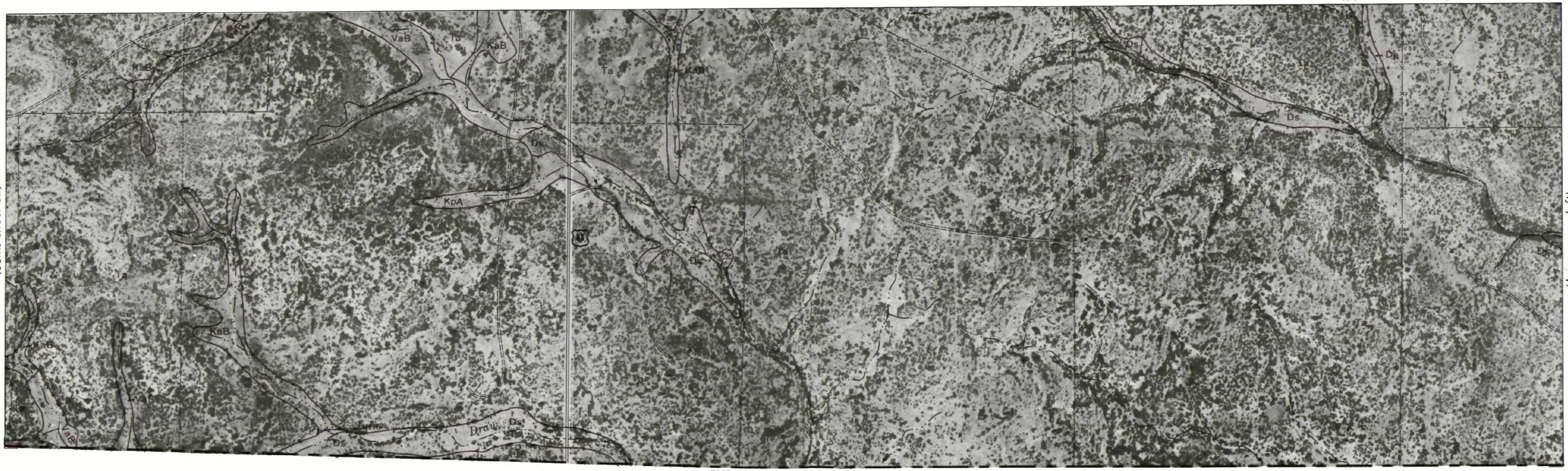


(Joins inset, sheet 64)

KIMBLE COUNTY

(Joins sheet 57)

(Joins sheet 62)



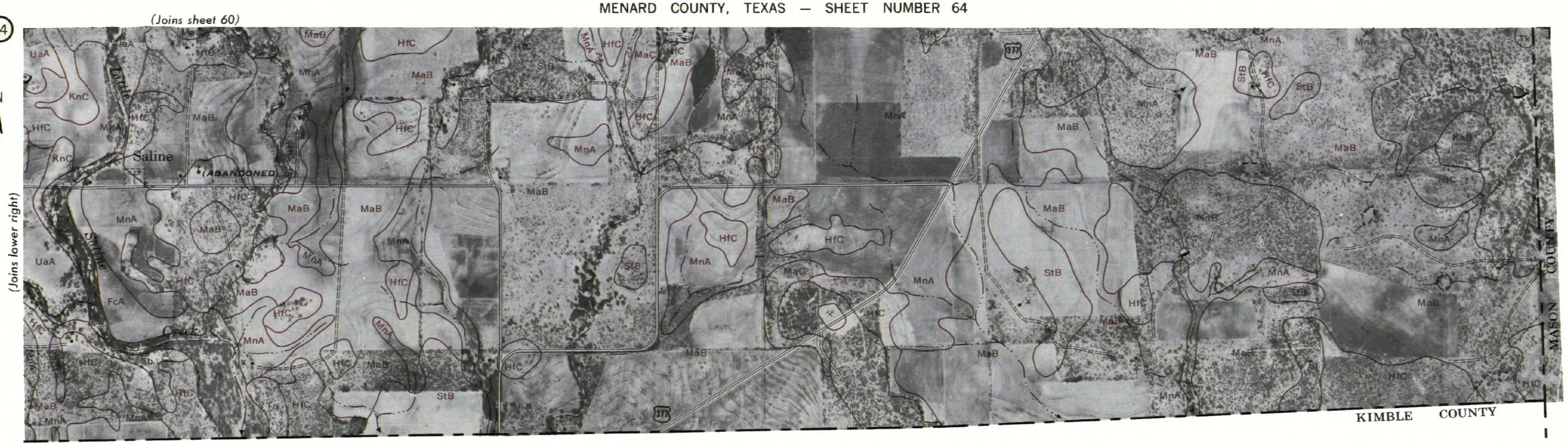
(Joins upper left)

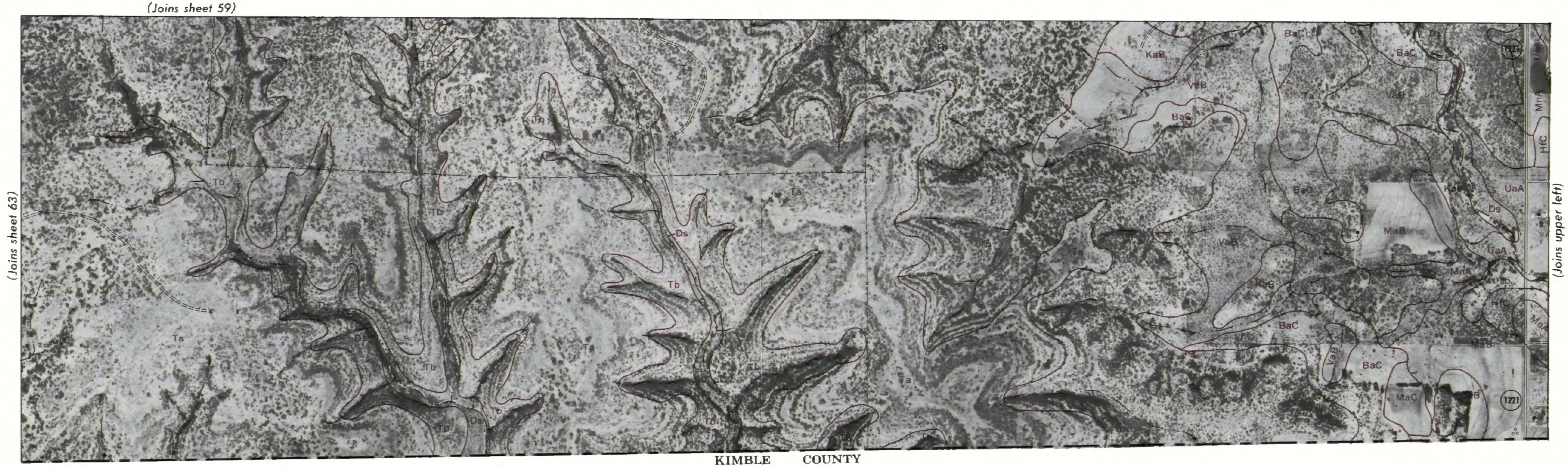
KIMBLE COUNTY

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1965 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station.

MENARD COUNTY, TEXAS — SHEET NUMBER 64





0 ½ 1 Mile Scale 1:20 000 0 5000 Feet